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NATIONAL DAM SAFETY PROGRAM. POTOMAC CREEK NUMBER 1 DAM (INVENT--ETC(U)
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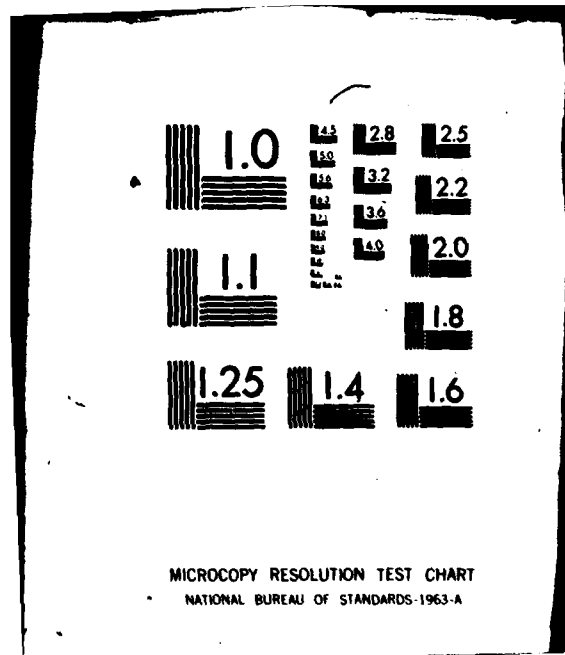
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Name Of Dam:

POTOMAC CREEK NO. 1

Location:

STAFFORD COUNTY, VIRGINIA

Inventory Number:

VA. NO. 17902

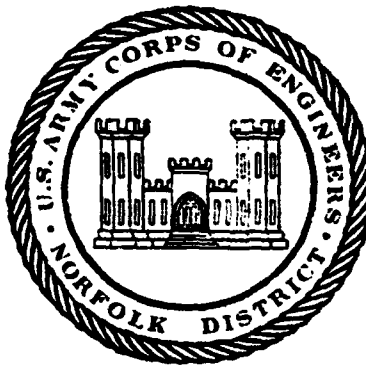
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PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

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PREPARED FOR

**NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510**

BY

**SCHNABEL ENGINEERING ASSOCIATES, P.C./
J. K. TIMMONS AND ASSOCIATES, INC.**

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20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

POTOMAC RIVER BASIN

NAME OF DAM: POTOMAC CREEK NO. 1 DAM
 LOCATION: STAFFORD COUNTY, VIRGINIA
 INVENTORY NUMBER: VA ~~17902~~ 17902

Potomac River Basin,
 Stafford County,
 Virginia.

PHASE I INSPECTION REPORT
 NATIONAL DAM SAFETY PROGRAM

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C., 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

BRIEF ASSESSMENT OF DAM

Name of Dam: Potomac Creek No. 1
State: Virginia
Location: Stafford County
USGS Quad Sheet: Stafford
Coordinates: Lat 38° 23.4' Long 77° 28.8'
Stream: Potomac Creek
Date of Inspection: 1 May 1980

Potomac Creek Dam No. 1 is a zoned earthfill structure about 960 ft long and 94 ft high. The principal spillway consists of a rectangular concrete riser and an outlet pipe which extends through the structure. Earth emergency spillways are located at the right abutment with a 400 ft wide bottom and 2H:1V side slopes, and at the left abutment with a 200 ft wide bottom and 2H:1V side slopes. The structure is classified intermediate in size and is assigned a significant hazard classification. The dam is located on Potomac Creek approximately seven miles north of Fredericksburg, Virginia. The lake is used for flood control and water supply to Stafford County, is owned by Stafford County and maintained by the Stafford County Sanitation District.

Based on criteria established by the Department of the Army, Office of the Chief of Engineers (OCE), the appropriate Spillway Design Flood (SDF) is the 1/2 PMF. The spillways will pass 80 percent of the Probable Maximum Flood (PMF) or 160 percent of the SDF without overtopping the dam. The spillways are adequate.

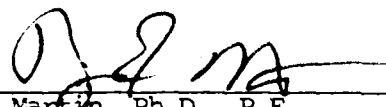
The visual inspection revealed no apparent problems. The inspection was performed at a time when the lake was drawn down approximately 25 ft below the normal pool level.

There was not sufficient data available to evaluate the embankment stability. The reported minimum factor of safety of 1.3 for the downstream slope for the steady seepage condition is less than the 1.5 required by U. S. Army, Corps of Engineers' guidelines. Therefore it is recommended that the owner engage the services of qualified Professional Engineers with expertise in Geotechnical Engineering to perform the necessary subsurface investigation and stability analysis to evaluate the stability of the dam. This work should commence within one year of the date of this report.

There is no routine maintenance operation program and no warning system. It is recommended that a warning system be established and the maintenance items listed in Section 7.3 be accomplished as part of the regular maintenance program within the next 12 months.

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Chief, Engineering Division

Date: **AUG 29 1980**



OVERVIEW OF RESERVOIR



OVERVIEW OF DAM (UPSTREAM SLOPE)

1 MAY 1980

SECTION I - PROJECT INFORMATION

1.1 General:

1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of safety inspection of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (see Reference 1, Appendix VI). The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Project Description:

1.2.1 Dam and Appurtenances: Potomac Creek No. 1 is a zoned earthfill structure approximately 960 ft long and 94 ft high.* The crest of the dam is 26 ft wide, and side slopes are approximately 3 horizontal to 1 vertical (3:1) on the upstream and downstream slopes of the dam. A 10 ft wide berm is shown on "as built" drawings between elevations 137.5 and 136.5 msl along the upstream slope. The crest of the dam is at elevation 167.1 msl.

The dam is keyed into the foundation and there is an internal drainage system with drain outlets. Existing vegetation on the embankment slopes and riprap along the upstream slope at normal pool level provide slope protection.

*Height is measured from the top of the dam to the downstream toe at the centerline of the stream.

The principal spillway consists of a 15 ft x 5 ft reinforced concrete riser inlet. The riser is connected to a 60 inch diameter reinforced concrete outlet pipe which runs through the dam. The riser crest is at elevation 139.2 msl. A 30 inch diameter sluice gate in the riser at an invert elevation of 75.3 msl is used to drain the lake. The outlet pipe has a length of 576 ft with an invert elevation at the outlet structure of 74.03 msl. There are three 10 inch diameter inlets on the riser structure at elevations 134.0, 113.3 and 98.3 msl, respectively, which are used for low water flow control. (See Plates No. 3 and 8, Appendix I).

The emergency spillways consist of two open channel earthen spillways located on the right and left abutments, each having a crest elevation of 159.4 msl. The right spillway is 400 ft wide, has 2H:1V side slopes, and is in a cut section. The left spillway has a bottom width of 200 ft, 2H:1V side slopes, and is also located in a cut section (See Plates No. 5 and 7, Appendix I).

1.2.2 Location: Potomac Creek Dam No. 1 is located on Potomac Creek approximately seven miles north of Fredericksburg, Virginia (See Plate No. 1, Appendix I).

1.2.3 Size Classification: The dam is classified as an "intermediate" size structure based on its height and maximum lake storage potential.

1.2.4 Hazard Classification: The dam is located in a rural area, however, based upon the proximity of several inhabited structures (motel and commercial facility) located several miles downstream, the dam is assigned a "significant" hazard classification. The hazard

classification used to categorize a dam is a function of location only and has nothing to do with its stability or probability of failure.

1.2.5 Ownership: The dam is owned by Stafford County and maintained by the Stafford County Sanitation District.

1.2.6 Purpose: Flood control and water supply for Stafford County.

1.2.7 Design and Construction History: The dam was designed and constructed under the supervision of the United States Department of Agriculture (USDA), Soil Conservation Service (SCS). Design was completed for the SCS by Martin, Clifford and Associates of Stafford, Virginia. The structure was constructed by Bailey and Associates and completed in 1970.

1.2.8 Normal Operational Procedures: The principal spillway is ungated, therefore, water rising above the crest of the riser inlet is automatically discharged downstream. Normal pool is maintained at elevation 139.7 msl at the crest of the riser. Flood discharges which cannot be absorbed by storage and the riser, flow through the emergency spillway at pool elevations above 159.4 msl. The 10 inch diameter inlets at elevations below normal pool are manually operated, and maintain a flow through the dam at low flow or reduced pool elevation conditions.

1.3 Pertinent Data:

1.3.1 Drainage Area: The drainage area is 30.5 square miles.

1.3.2 Discharge at Dam Site: According to Mr. Don Farmer (SCS) the maximum known flood at the dam site occurred in June 1972 when an estimated pool elevation of 161 msl was observed. This corresponds to an approximate discharge of 3152 CFS.

Principal Spillway Discharge:

Pool Elevation at Crest of Dam (elev 167.1) 778.4 CFS

Emergency Spillway Discharge:

Pool Elevation at Crest of Dam (elev 167.1) 35,200 CFS

1.3.3 Dam and Reservoir Data: See Table 1.1, below:

Table 1.1 DAM AND RESERVOIR DATA

Item	Reservoir				
	Elevation feet msl	Storage			
		Area Acres	Volume Acre Feet	Watershed Inches	Length Miles
Crest of Dam	167.1	383	11,400	7.01	3.4
Emergency Spillway Crest	159.4	312	8,800	5.41	3.1
Principal Spillway Crest	139.2	185	4,000	2.46	2.5
Streambed at Down- stream Toe of Dam	73	-	-	-	-

SECTION 2 - ENGINEERING DATA

2.1 Design: The dam was designed and constructed under the direction of the USDA, Soil Conservation Service and was sponsored by Stafford County, Virginia. "As built" drawings and design data are available in the office of the State Conservationist, U.S. Soil Conservation Service, Federal Building, Room 9201, 5th and Marshall Streets, Richmond, Virginia 23240.

A subsurface investigation was conducted at the site by Woodward-Clyde-Sherard and Associates during the initial design stages. The investigation consisted of drilling 13 test borings and excavating 15 test pits in the preliminary study and drilling 43 test borings in the final study. Subsurface profiles and a report of the investigation with foundation recommendations were prepared based upon geologic field reconnaissance, test boring and test pit data, field permeability tests and laboratory testing. The Foundation Investigation Report and supplemented laboratory test data are available at the above referenced SCS office. Test boring and test pit locations are shown on Plate No. 2 of Appendix I. Subsurface profiles are shown on Plates No. 5 and 7 of Appendix I.

The dam is a zoned, compacted earthfill embankment. The earth fill requirements shown on Plate No. 3, Appendix I, specify that clayey silts or silts (ML), silty clays (CL) and clays (CH) be used in Zone I of the dam. Soil classification is by the Unified Soil Classification System, ASTM D-2487. Zone II of the dam consists of decomposed gneiss material, which probably classifies as silts (ML), silty sands (SM), gravelly sands and sandy gravels (GM).

A review of design drawings indicates the dam is founded on overburden and includes a cutoff trench which extends into "firm unweathered rock" (See Plate No. 5, Appendix I). Pressure test data developed in Boring B-1 and B-3 show the overburden materials are susceptible to water loss under pressure. However, water loss was negligible below elevation 120[±] to 115[±] in the unweathered bedrock. The foundation report indicated that the decomposed gneiss underlying the site would be subject to piping, ravelling and erosion in its natural state and possibly in a compacted state.

To control the phreatic water surface and to collect seepages, an internal drainage system was constructed along the downstream portion of the dam. This drainage system consists of a 5 ft thick chimney drain having a maximum elevation of 140 msl. The chimney drain was designed assuming a compacted permeability of the upstream embankment material of $k = 1 \times 10^{-5}$ cm/sec. Water collected in the chimney drain enters a perforated corrugated metal pipe which runs along its base. Water exits through two 10 inch pipes at the plunge pool. A "drain fill" or drainage blanket surrounds the outlet pipes. A rock fill was also constructed at the downstream toe. "As built" drawings of this drainage system are presented on Plates No. 3 and 6 of Appendix I.

The principal spillway was designed as a drop inlet structure consisting of a reinforced concrete riser, a transition section at the base of the riser, a 60 inch conduit and a stilling basin or plunge pool at the outlet end of the conduit. Three water supply

gates were provided at various elevations in the riser for release of water for municipal usage. Twelve reinforced concrete anti-seep collars spaced at 24 ft intervals were installed around the principal spillway pipe, upstream of the chimney drain in order to control any potential piping problems along the pipe. Details of the principal spillway and riser are presented on Plates No. 3 and 8 of Appendix I.

The emergency spillways were designed as trapezoidal channels cut into various areas of clay, decomposed gneiss and unweathered rock. The spillways are basically in cut material, however, specifications required that areas where the bottom of the spillway was not in rock, be undercut 1 ft and be replaced by fill compacted to 95% of maximum dry density, per ASTM D-698. The spillways are separated from the dam by natural hillsides.

The design report summary (Appendix IV) dated January 1968 indicates the stability analysis was performed using a shear strength parameter $\phi = 26^\circ$ for the decomposed gneiss section of the dam which comprises the downstream slope. The design report summary does not indicate the type of stability analysis performed but indicates the embankment section was "derived by an approximate stability analysis . . . significantly influenced by experience and judgement."

2.2 Construction: The construction records were not furnished by the SCS office Richmond, but they are available from the SCS office in Washington, D.C.

2.3 Evaluation: The "as built" drawings are representative of the dam. There is sufficient information to evaluate foundation conditions, however, there is insufficient data available to evaluate the embankment stability.

SECTION 3 - VISUAL INSPECTION

3.1 Findings: At the time of inspection, the dam was in good condition. Field observations are outlined in Appendix III.

3.1.1 General: An inspection was made on 1 May 1980. The weather was cloudy with intermittent rain and the temperature was about 55° F. The pool and tailwater levels at the time of inspection were 114 and 74 msl, respectively. This corresponds to a below normal pool elevation due to construction requirements and an above normal tailwater elevation due to recent rains. Normal pool is at elevation 139.7 msl, however, the lake level had been drawn down for approximately 6 months to facilitate construction at the adjacent water treatment plant. Ground conditions were wet at the time of inspection. Previous inspections were made by the Soil Conservation Service as part of their annual inspection and reports of the inspections are included in Appendix V.

3.1.2 Dam and Spillway: No vegetation exists on that portion of the upstream slope which was exposed as a result of the lowered lake level. Otherwise the embankment slopes, crest and most of the emergency spillways were grassed (1 to 3 ft high) and included occasional brush. No seepage was observed. A rather thin (2 ft± wide) continuous, wet or marshy zone was encountered across the downstream slope, approximately 36 ft above the top of the principal spillway outlet pipe. This zone extended 50 ft± right and 100 ft± left of the vehicle tracks. (See Sheet 1, Appendix III).

Erosion or rutting related to four-wheel drive vehicle traffic exists on the downstream face of the dam (see Photo No. 1, Appendix II), along the crest of the dam, and across the left emergency spillway. The emergency spillway at the right abutment was eroded along an unpaved access road (Photo No. 3, Appendix II). This area incurred major erosion at the lower end from the 1972 flood (Photo No. 8, Appendix II), and was partially filled with construction debris from the adjacent water treatment plant. Since lowering of the lake level, considerable erosion has developed along the upstream slope near the left upstream abutment area as a result of surface runoff along a formerly submerged stream channel (Photo No. 7, Appendix II). Scattered shallow gullies approximately 1 ft wide and 1 ft deep also occur along the downstream slope and above the riprap present along the lower reaches of the left and right abutment - dam contacts.

Fresh granite gneiss was exposed in the left abutment area about 30 ft above the plunge pool. A strike of 39° northeast and dips of 25° to 45° southeast were measured on the foliation or "slaty cleavage" exposed in the rock. Jointing was also noted in the rock. Residual soils (decomposed granite gneiss) are also exposed in the lower portion of the right emergency spillway channel. Foliation strikes of 45° northeast and dips ranging from 90° to 75° southeast were measured. No faults were encountered during the inspection.

Two 10 inch CMP drains were observed, one on each side of the 5 ft outlet pipe. Clear water was flowing at approximately 1 gpm from each drain, however, the right drain was partially clogged at its outlet.

The riser structure and outlet pipe showed no signs of deterioration and were functioning properly at the time of inspection. The slide gates were reportedly in good operating condition except that the upper 10-inch diameter gate was missing. The plunge pool riprap was intact indicating no signs of movement or erosion. Riprap present on the upstream slope and along the lower reaches of the downstream slope - abutment contacts also appeared to be functioning properly and in good condition. The 10 ft wide berm shown on the "as built" drawings directly below the riprap on the upstream slope was not encountered.

3.1.3 Reservoir Area: The reservoir area was free of debris and the perimeter was wooded. The reservoir is located in a valley with side slopes at approximately 3H:1V. No sediment buildup was observed.

3.1.4 Downstream Area: The downstream channel consists of a 35 ft wide channel located in a valley with side slopes of 3H:1V. This valley is heavily wooded. Approximately two miles downstream where Potomac Creek crosses U. S. Route 1, there is a motel and commercial facility about 10 ft and 12 ft above the streambed, respectively.

3.1.5 Instrumentation: No instrumentation (monuments, observation wells, piezometers, etc.) was encountered for the structure. There is no staff gage.

3.2 Evaluation

3.2.1 Dam and Spillways: Overall the dam was in good condition at the time of inspection, however, some minor remedial measures are necessary. As indicated in previous inspection reports by Soil Conservation Service personnel, the need still exists for correcting the

surface erosion caused by vehicular traffic on the dam and emergency spillways. The vegetative cover still requires attention. Also noted was the missing 10 inch water control gate.

Vehicular traffic on the dam tends to damage the embankment slopes and make these areas more susceptible to surface erosion. This in turn increases the potential for slope failure. In order to insure the integrity of the dam, future vehicular traffic should be prevented and existing eroded areas backfilled with compacted soil and reseeded. Any areas to remain as access roads should be surfaced to prevent erosion. The shallow erosional features described on the downstream slope and along the abutment contacts should be reseeded. The eroded area observed along the upstream slope near the left abutment (Photo No. 7, Appendix II), should be backfilled with compacted soil prior to raising the lake to normal pool level. Construction debris present in the right emergency spillway should be removed and the severely eroded lower section should be repaired in attempt to prevent further erosion.

Uncontrolled growth encourages the development of deep rooted vegetation. This type of growth can encourage piping within the embankment and undermine riprap protection. Also, excessive growth inhibits effective visual inspections of the dam. The embankment, including its crest, slopes and emergency spillways should be mowed at least once a year, but more preferably twice a year. No trees were observed on the embankment. If small trees should appear, they should be cut to the ground.

The continuous, wet or marshy area observed along the downstream slope is not believed to represent seepage through the dam because an internal drainage system exists for this structure and particularly since the lake level was 25 ft[±] below normal pool level at the time of inspection. It is likely this area is the result of accumulated surface runoff. It is recommended that this area be observed in future SCS inspections and during normal maintenance operations to verify that this zone does not represent seepage through the dam.

The outlet pipe and intake structure are in good structural condition. The operating appurtenances are functionally good and the missing 10 inch slide gate should be replaced. Although the 10 ft wide berm was not noticeable at the upstream slope, it has probably been covered with riprap. A staff gage should be installed to monitor water levels.

3.2.2 Downstream Area: A breach in the Potomac Creek No. 1 Dam during extreme flooding would create a hazard to the downstream dwelling along U. S. Route 1.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: The normal storage pool is elevation 139.7 0.5 ft above the crest of the concrete principal spillway inlet. The lake provides water supply, flood control storage and offers minimal recreation. Water passes automatically through the principal spillway as the water level in the reservoir rises above the principal spillway crest. Water will also pass automatically through the emergency spillway when the water level in the reservoir reaches elevation 159.4. A 30 inch slide gate valve at the low point in the riser structure and three 10 inch slide gate valves are provided to drawdown the reservoir from normal pool. A new raw water intake structure is under construction on the right side of the reservoir approximately 1000 ft upstream from the dam. The raw water intake will draw off water from the reservoir at a rate required by the water treatment plant.

4.2 Maintenance of Dam and Appurtenances: Maintenance is the responsibility of the owner. Maintenance consists of inspection, debris removal, mowing of vegetative cover, and repair. Maintenance is not routinely performed.

4.3 Warning System: At the present time there is no warning system or evacuation plan for the dam.

4.4 Evaluation: The dam and appurtenances are in good operating condition; however, maintenance of the dam appeared to be inadequate. A routine maintenance program should be developed for this structure.

An emergency operation and warning plan should be developed. It is recommended that a formal emergency procedure be prepared and furnished to all operating personnel. This should include:

- a. How to operate the dam during an emergency.
- b. Who to notify, including public officials, in case evacuation from the downstream area is necessary.

SECTION 5 - HYDRAULICS/HYDROLOGIC DATA

5.1 Design: Potomac Creek Dam No. 1 was designed by the Soil Conservation Service (SCS) as a multi-purpose dam and complete hydrologic and hydraulic data are available, including stage-discharge, stage-storage, stage-area, inflow hydrograph and flood routing data. This structure is a Class "C" dam according to the SCS classification method.

5.2 Hydrologic Records: There are no records available.

5.3 Flood Experience: According to Mr. Don Farmer (USDA, SCS), an estimated maximum pool elevation of 161 msl occurred in June 1972 during Hurricane Agnes. This corresponds to a peak flow of approximately 3152 CFS.

5.4 Flood Potentials: In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region), or fractions thereof. The Probable Maximum Flood (PMF) and $\frac{1}{2}$ PMF hydrographs were developed by the SCS method (Reference 4, Appendix VI). Precipitation amounts for the flood hydrograph of the PMF were taken from U.S. Weather Bureau Information (Reference 5, Appendix VI). Appropriate adjustments for basin size and shape were accounted for. These hydrographs were routed through the reservoir to determine maximum pool elevations.

5.5 Reservoir Regulations: For routing purposes, the pool at the beginning of flood was assumed to be at elevation 140 msl. Reservoir stage-storage data and stage-discharge data were determined from the design report and verified for pool elevations up to 161.7 msl. Above pool elevation 161.7 msl stage-storage data was extrapolated from the existing curves and stage-discharge data was computed for the non-overflow section along with extrapolation of stage-discharge curves. Floods were routed through the reservoir

using the principal spillway discharge up to a pool storage elevation of 159.4 msl and a combined principal and emergency discharges for pool elevations above 159.4 msl. Pool elevations above 167.1 msl were routed over the non overflow section of the dam.

5.6 Overtopping Potential: The predicted rise of the reservoir pool and other pertinent data were determined by routing the flood hydrographs through the reservoir as previously described. The results for the flood conditions ($\frac{1}{2}$ PMF and PMF) and shown in the following Table 5.1.

TABLE 5.1 RESERVOIR PERFORMANCE

	Normal Flow	Hydrograph	
		$\frac{1}{2}$ PMF	PMF
Peak Flow, CFS			
Inflow	30	23,589	47,177
Outflow	30	17,786	47,177
Maximum Pool Elevation Ft, msl	139.7	163.94	168.3
Non-Overflow Section (Elev 167.1 msl)			
Depth of Flow, Ft	-	-	1.2
Duration, Hours	-	-	3.0
Velocity, fps	-	-	4.7
Emergency Spillway (Elev 159.4 msl)			
Depth of Flow, Ft	-	4.54	8.9
Duration, Hours	-	21.0	24.0
Velocity, fps *	-	9.6	12.9
Tailwater Elevation, Ft, msl	73.5	99.	112

* Critical velocity at control section

5.7 Reservoir Emptying Potential: A 30-inch diameter gate at elevation 75.3 msl is capable of draining the reservoir through the outlet culverts. Assuming that the lake is at normal pool elevation (139.7 msl) and there is 30 cfs inflow, it would take approximately 16 days to lower the reservoir to elevation 76 msl. This is equivalent to an approximate drawdown rate of 4.0 ft/day based on the hydraulic height measured from normal pool to the invert of the drawdown pipe divided by the time to dewater the reservoir.

5.8 Evaluation: The U. S. Army, Corps of Engineers' guidelines indicate the appropriate Spillway Design Flood (SDF) for an intermediate size, significant hazard dam is the $\frac{1}{2}$ PMF to PMF. Because of the risk involved, the $\frac{1}{2}$ PMF has been selected as the SDF. The spillway will pass 80 percent of the PMF without overtopping the crest of the dam (160 percent of the SDF).

Hydrologic data used in the evaluation pertains to present day conditions with no consideration given to future development.

SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: The dam is located along the eastern edge of the Piedmont Physiographic Province of Virginia. Higher elevations at the site are blanketed with a thin veneer of Coastal Plain sediments, consisting of variable amounts of sand, silt, clay and gravel. These sediments include the Patuxent and "Lafayette" (Appendix VI, References 6 and 9) Formations, of Cretaceous to Pliocene Age. These materials are underlain by residual sands and clays, which are derived from the in-place weathering of underlying granite gneiss bedrock (Precambrian Age). Test borings indicate that the bedrock becomes less weathered with depth and that the granite gneiss grades into a fresh gneissoid granite. The bedrock is generally jointed, fractured, and foliated, however, these structural features are less obvious in unweathered rock. Available geologic maps of the area do not indicate the presence of any faults in the site vicinity.

Subsurface data indicates the overburden materials possess low to high natural permeabilities. Pressure tests resulted in low water takes despite known jointing, foliation and fracturing of the bedrock. It was concluded in the foundation report that the underlying unweathered rock would provide "a relatively impervious base for the dam and reservoir area."

Foundation materials in the valley floor were described in the foundation report as "relatively incompressible except for the thin clay layer over random sections in the valley." Total settlement of the crest along centerline of the embankment was estimated to

range from 1 to 2 ft. Time rate of settlement computations indicated that 75% of the total settlement would occur during construction and the remaining settlement was expected to extend over a period of 18 months. Based upon design data, a stable foundation is assumed for this structure.

6.2 Embankment:

6.2.1 Materials: "As built" drawings show the dam as a zoned structure. Zone I of the dam was constructed with clayey silt to silt (ML), silty clay (CL) and clay (CH) materials. Zone II was constructed with decomposed gneiss, which probably classified as SM to GM. Materials in both zones were to be compacted to 95% of maximum dry density in accordance with ASTM Standard D-698 (Standard Proctor). Maximum lift thicknesses of 9 inches and maximum rock sizes of 6 inches were specified.

6.2.2 Subdrains and Seepage: No special foundation treatment was required. In attempt to control seepage, a cutoff was constructed into "reasonably sound rock" along centerline of the embankment. A chimney drain was included within the downstream portion of the dam in order to lower the phreatic surface through the embankment. Drainage pipes incorporated in a blanket filter were provided for transmitting the collected water to the plunge pool. Rock fill was also utilized at the toe of the dam. In attempt to prevent piping around the principal spillway pipe, 12 anti-seep collars were included upstream of the chimney drain. Details of the drainage system and cutoff are provided on Plates No. 3, 5 and 6 of Appendix I. No

seepage was observed during the inspection, however, the lake was approximately 25 ft below normal pool level. Both chimney drain outlets were flowing at about 1 gpm at the time of the inspection.

6.2.3 Stability: The only information stated in the design report concerning the stability analysis is that the embankment section was derived by an "approximate stability analysis" and was also "significantly influenced by experience and judgement" (page 10, Appendix IV). It was also stated that "the embankment has a minimum safety factor of 1.3 based on a ϕ angle of 26° in the decomposed gneiss section (page 7, Appendix IV). Since the decomposed gneiss comprises the downstream embankment we assume the above factor of safety was derived from a downstream analysis and therefore represents steady state seepage conditions. The only stability calculations made available included computer printouts of analysis of upstream slope conditions which did not correspond to the 3H:1V "as built slope" and thus are not included herein.

The dam is 94 ft high and has a crest width of 26 ft. The base width of the dam at the principal spillway is about 594 ft. The upstream slope is 3H:1V with a 10 ft wide berm provided between elevations 137.5 and 136.5 msl. The downstream slope is 3H:1V. The dam is subjected to rapid drawdown as the approximate reservoir drawdown rate of 4.0 ft per day exceeds the critical rate of 0.5 ft per day for earth dams. The existing pool is approximately 25 ft below maximum control storage pool which is at the crest of the principal spillway. Upon completion of the water treatment plant the lake will return to normal pool level which is the maximum control

storage pool. The dam has experienced the maximum control storage pool with no apparent side effects.

According to the Recommended Guidelines for Safety Inspection of Dams (Reference 1, Appendix VI). the recommended factor of safety for steady seepage conditions is 1.5. Based upon the available data obtained indicating the minimum factor of safety of 1.3, the embankment slopes are considered inadequate.

6.2.4 Seismic Stability: The dam is located in Seismic Zone 2. Therefore, according to the Recommended Guidelines for Safety Inspection of Dams, the dam is considered to have no hazard from earthquakes provided static stability conditions are satisfactory and conventional safety margins exist.

6.3 Evaluation: An accurate check on the stability of this structure cannot be made since there are no detailed calculations available. The factor of safety for the embankment slopes does not meet the requirements recommended by U. S. Army Corps of Engineers' guidelines. Therefore, it is recommended that the owner have a qualified Professional Engineer with expertise in Geotechnical Engineering perform a stability analysis in order to evaluate the safety of the dam.

Since no undue settlement, cracking, or sloughing was noted at the time of inspection, it appears that the embankment is adequate for control storage with water at elevation 114 msl.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: Sufficient engineering data is available for assessing the dam except for stability. The visual inspection revealed no findings that proved the dam to be unsound, however, it should be emphasized that the inspection occurred at a time when the lake was drawn down approximately 25 ft below normal pool level. A routine maintenance program does not exist. Also, there is no emergency operation and warning plan. Overall, the dam was in good condition at the time of inspection. U. S. Army, Corps of Engineers guidelines indicate the appropriate Spillway Design Flood (SDF) for this dam is the $\frac{1}{2}$ PMF. The spillway will pass 80 percent of the PMF (160% of the SDF) without overtopping the crest of the dam. The spillway is judged adequate. Review of available stability data indicated the embankment slopes do not meet U. S. Army Corps of Engineers' guidelines.

7.2 Recommended Remedial Measure: The following remedial measure should be implemented within one year of the date of this report. The Owner should engage the services of qualified Professional Engineers with expertise in Geotechnical Engineering to perform necessary studies and design work.

7.2.1 Perform a subsurface investigation and stability analysis in order to evaluate the stability of the dam and modify as necessary.

7.3 Required Maintenance: It is recommended that a regular maintenance operation program be established and documented for future

reference. A formal emergency procedure should be prepared and furnished to all operating personnel. This should include how to operate the dam during an emergency, and who to notify including public officials, in case evacuation from the downstream area is necessary. Also, the inspection revealed the following maintenance items that should be scheduled by the owner during a regular maintenance period within the next 12 months:

a) Vehicular traffic on the embankment and in the emergency spillways should be prevented. Eroded areas caused by this traffic should be backfilled with compacted soils and reseeded. Any areas to remain as access roads should be surfaced to prevent erosion.

b) The eroded area present along the upstream slope of the dam near the left abutment should be backfilled with compacted soil prior to raising the lake back to normal pool level.

c) Construction debris present in the right emergency spillway should be removed.

d) The severely eroded lower section of the right emergency spillway should be repaired in order to prevent further erosion during usage.

e) The grass and weeds on the dam embankment and in the emergency spillways should be cut at least once a year and preferably twice a year. Maintenance is recommended in the early summer and fall.

f) The shallow erosional features described on the downstream slope and along abutment contacts should be reseeded.

g) The thin saturated area present on the downstream slope should be monitored during normal maintenance operations, particularly once normal pool levels are resumed, in order to verify that this condition is not related to seepage passing through the dam. If increased saturation or flow should occur, a professional Geotechnical Engineer should be contacted to evaluate the problem and make recommendations for required corrective measures.

h) The missing 10 inch slide gate on the intake structure should be replaced.

i) A staff gage should be installed to monitor water levels.

APPENDIX I
MAPS AND DRAWINGS



Mountain View

Ramoth

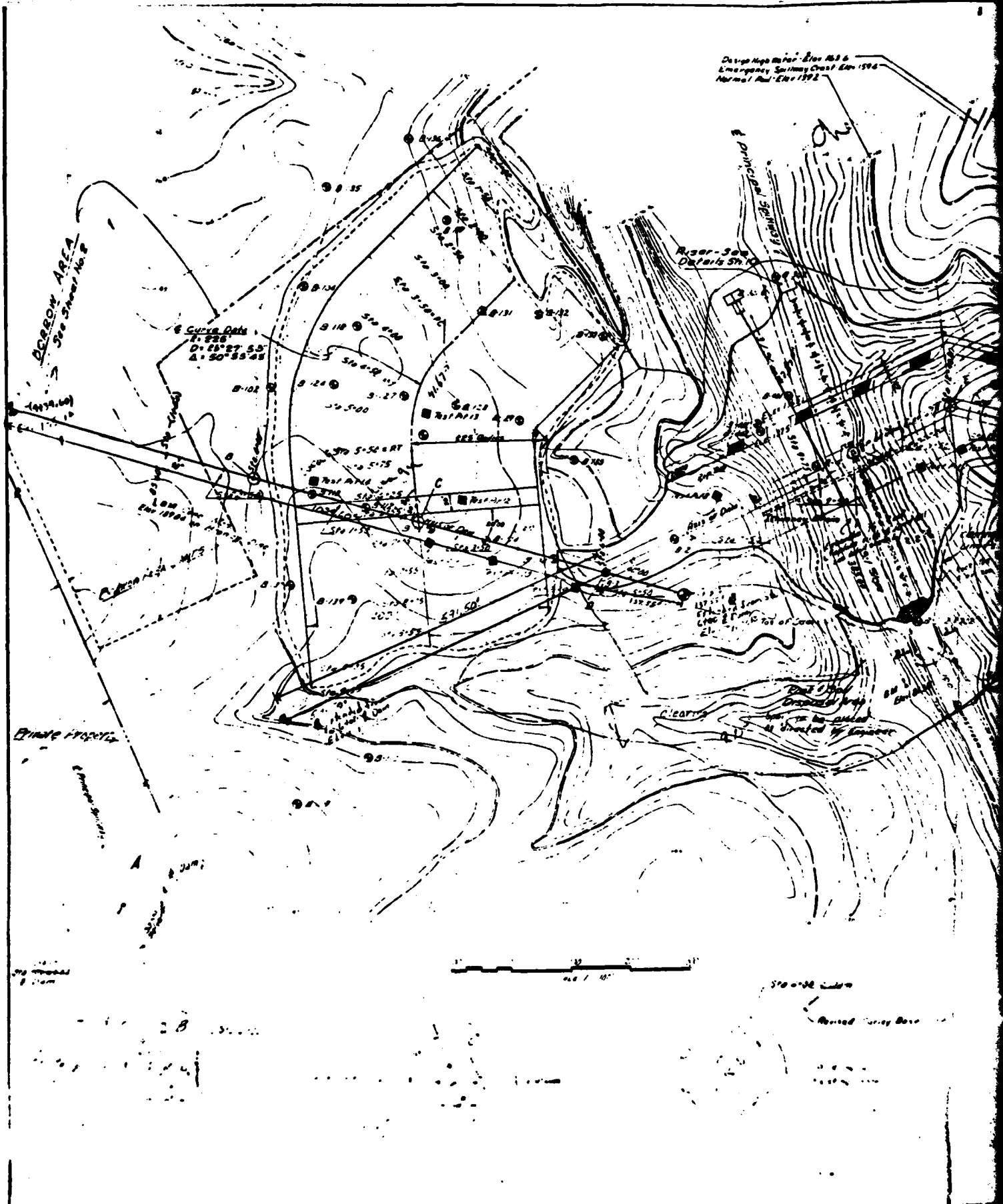
Creek

DRAINAGE AREA

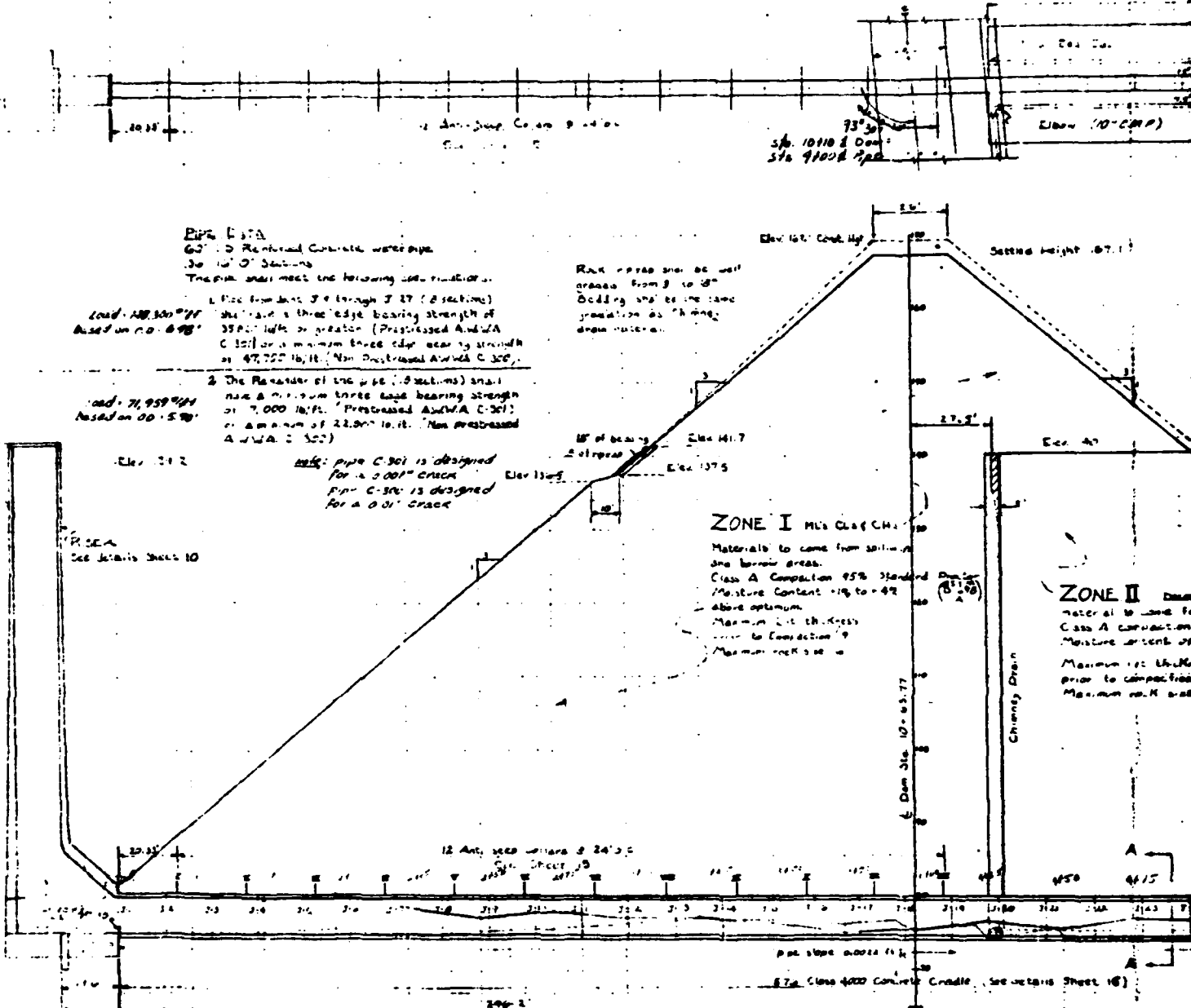
POTOMAC DAM NO. 1

SCALE: 1" = 2000'
PLATE NO. 1

STAFFORD, VA.
N-5025 W7725-75



PLAN VIEW



PIPE DATA

60" O.D. Reinforced Concrete water pipe
30' 10" O' Sections
The pipe shall meet the following specifications:

Load: 100,000 lb/ft
Based on 10' 0" S.P.

Load: 71,959 lb/ft
Based on 10' 0" S.P.

1. Pipe from joint 3 to through 3 (2 sections) shall have a three edge bearing strength of 33,000 lb/ft. or greater (Prestressed A.W.W.A. C-301) or a minimum three edge bearing strength of 47,250 lb/ft. (Non Prestressed A.W.W.A. C-302).

2. The remainder of the pipe (2 sections) shall have a minimum three edge bearing strength of 7,000 lb/ft. (Prestressed A.W.W.A. C-301) or a minimum of 22,000 lb/ft. (Non Prestressed A.W.W.A. C-302).

Note: pipe C-301 is designed for a 0.001" crack
Pipe C-302 is designed for a 0.01" crack

Rock in place shall be well graded from 3" to 18"
Grading shall be the same gradation as filling drain material.

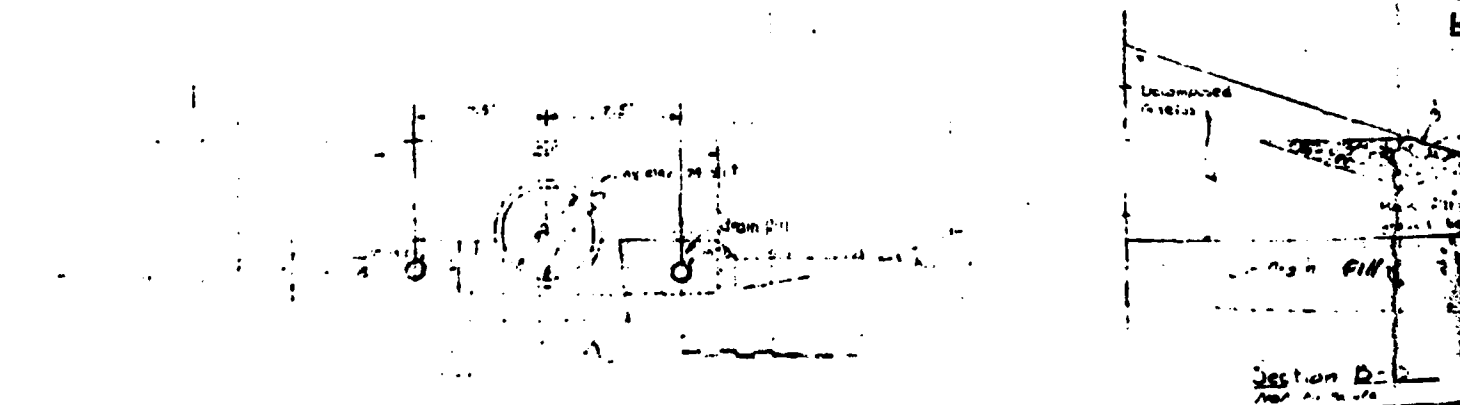
ZONE I M.H. Class C.H.

Materials to come from borrow and borrow areas.
Class A Compaction 95% Standard
Moisture Content 14% to 19%
Maximum wet thickness 12"
Maximum wet thickness prior to compaction 18"
Maximum wet thickness 12"

ZONE II

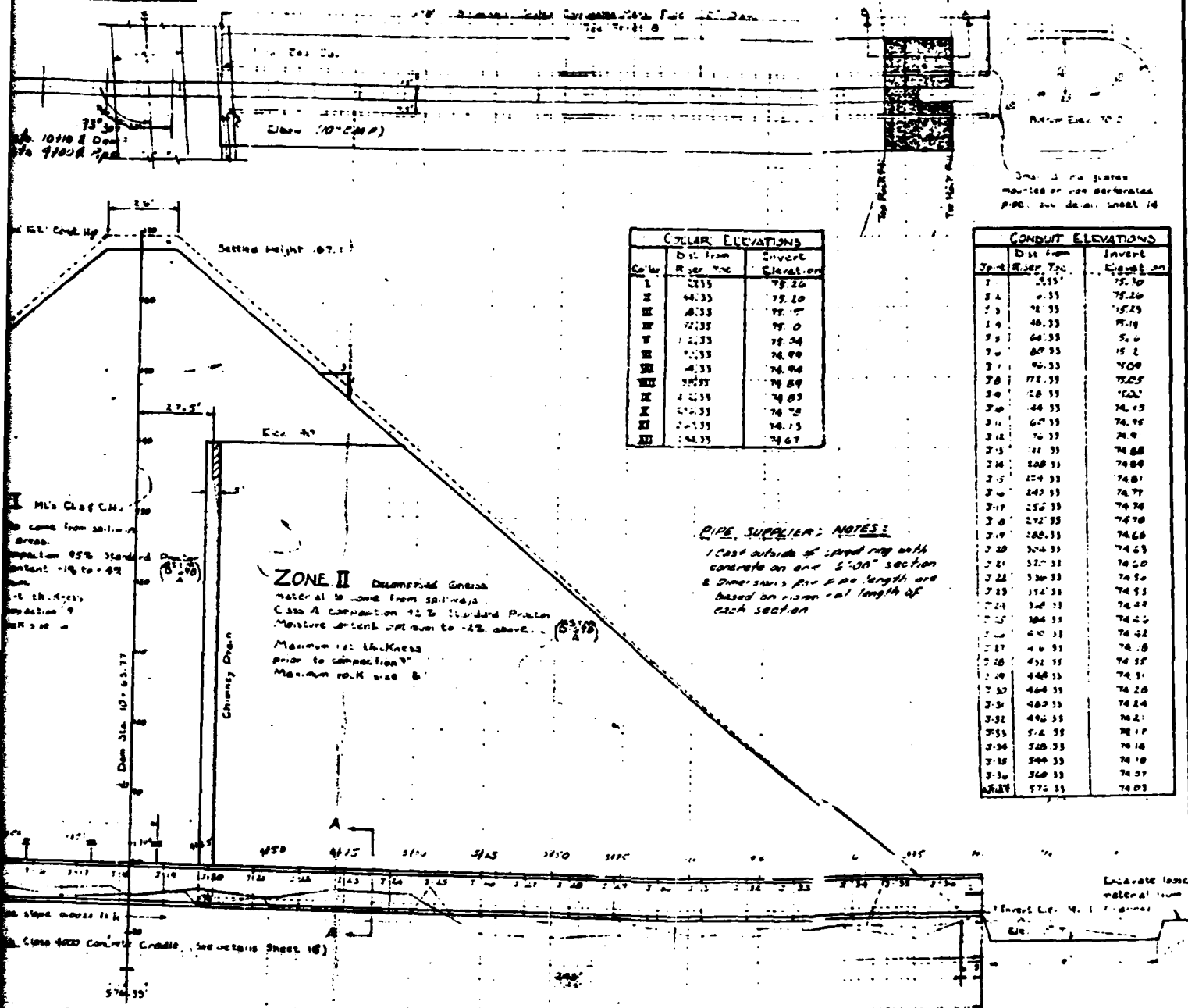
Material to come from Class A compaction.
Moisture Content 14%
Maximum wet thickness prior to compaction 18"
Maximum wet thickness 12"

PROFILE OF DAM ALONG E OF PRINCIPAL SPILLWAY



Section B-B
Not to scale

PLAN VIEW



CONDUIT ELEVATIONS		
Conduit	Dist. from River Face	Invert Elevation
1	53.55	75.20
2	44.33	75.20
3	40.33	75.17
4	42.33	75.00
5	42.33	75.04
6	42.33	74.99
7	42.33	74.96
8	42.33	74.89
9	42.33	74.83
10	42.33	74.75
11	42.33	74.67

CONDUIT ELEVATIONS		
Spillway	Dist. from River Face	Invert Elevation
1	53.55	75.20
2	44.33	75.20
3	40.33	75.17
4	42.33	75.00
5	42.33	75.04
6	42.33	74.99
7	42.33	74.96
8	42.33	74.89
9	42.33	74.83
10	42.33	74.75
11	42.33	74.67

PIPE SUPPLIER'S NOTES:
 1. Cast outside of pipe ring with concrete on one 5'00" section & dimensions per pipe length are based on nominal length of each section.

ZONE II Decomposed Gneiss material to come from spillways. Class A compaction 95% Standard Proctor. Moisture content not over 12% above...
 Maximum 12" thickness prior to compaction.
 Maximum rock size 8"

Vertical Scale: 1" = 10'
 Horizontal Scale: 1" = 25'

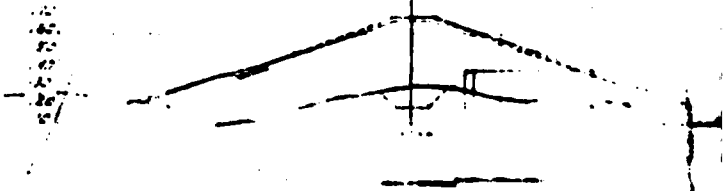
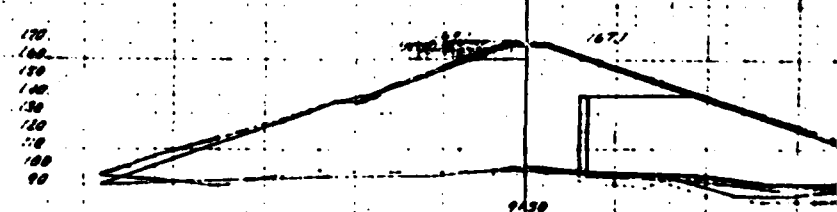
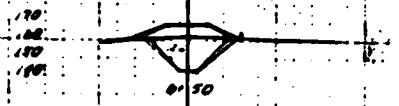
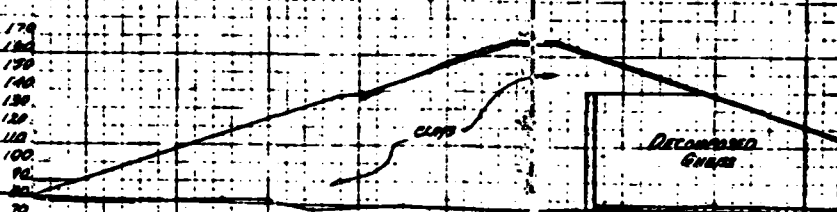
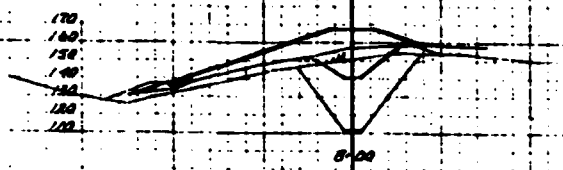
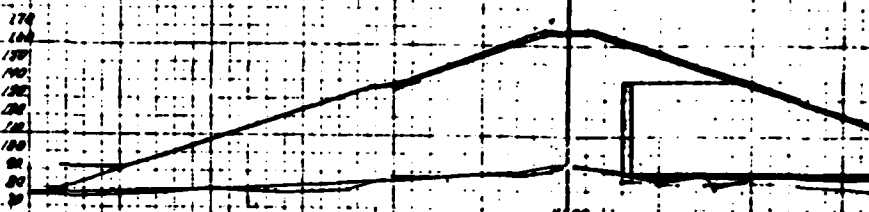
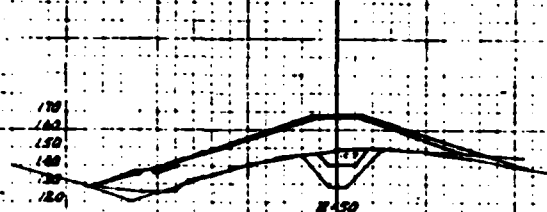
AS E-JILT PLATE NO. 3

DAM NO. 1 POTOMAC CREEK
 POTOMAC CREEK WATERSHED
 STAFFORD COUNTY, VIRGINIA

CROSS SECTION OF DAM AT PRINCIPAL SPILLWAY
 S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE

Section D-D
 May 1950

8 VA 590-P



0 5-4 5-25

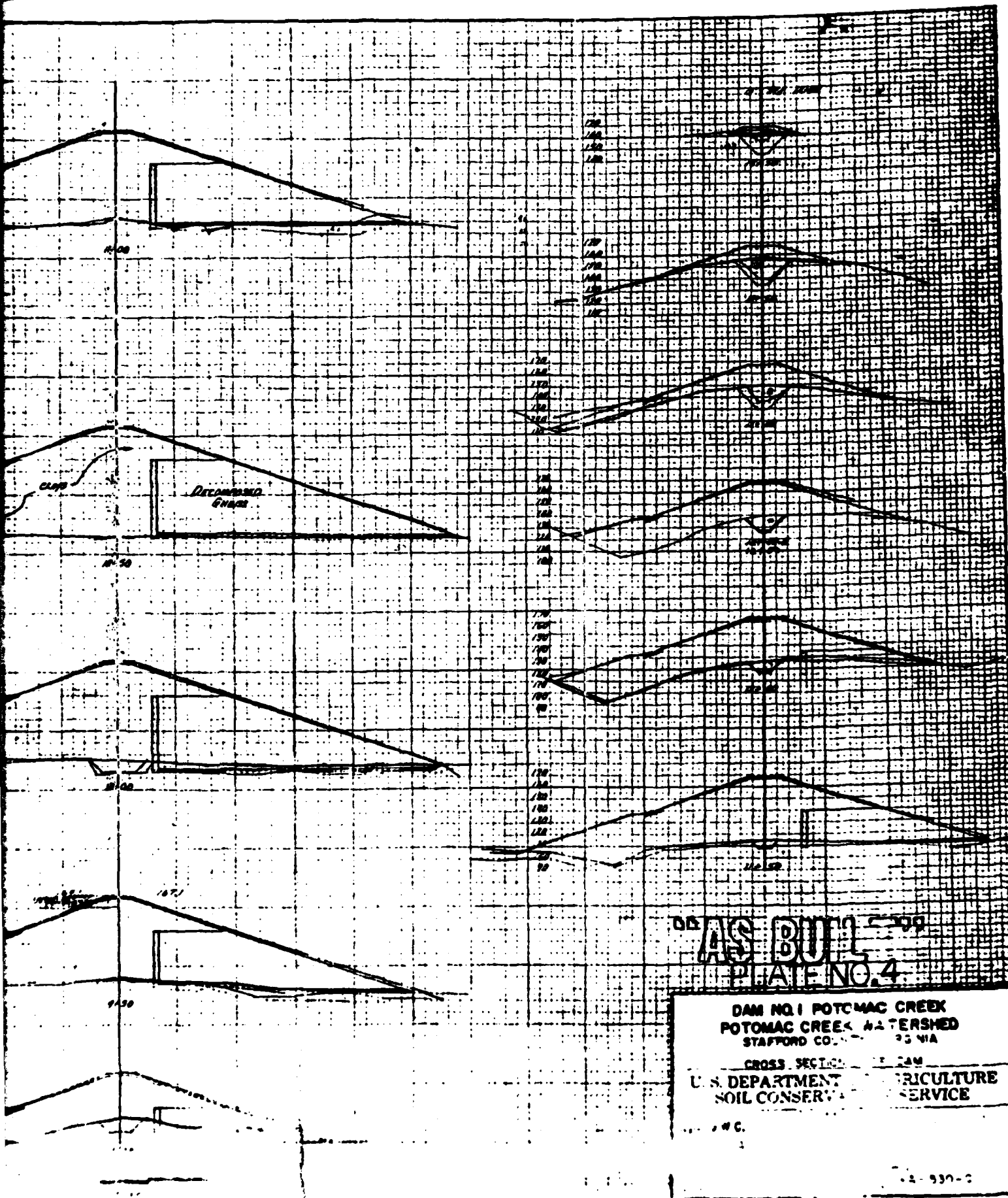
DECOMPOSED

8-50

8-00

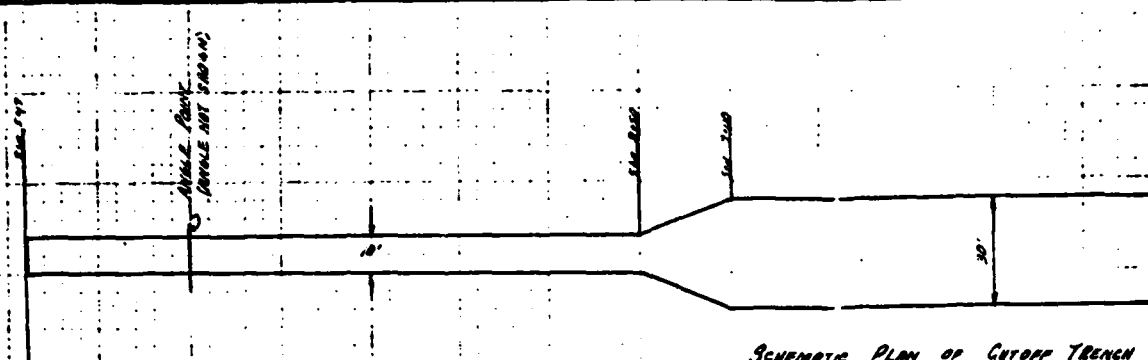
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10-00

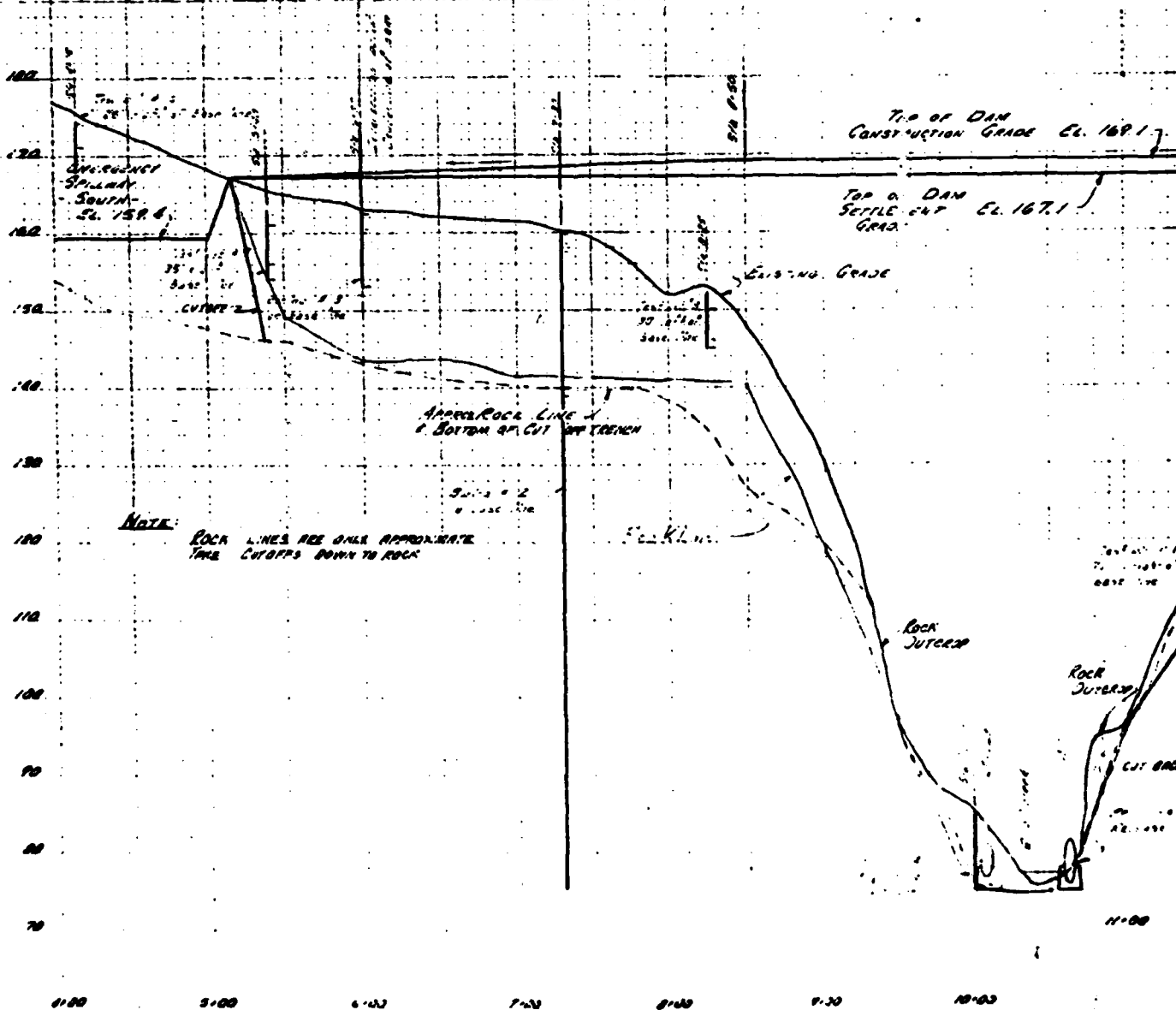


AS BULL
 PLATE NO. 4

DAM NO. 1 POTOMAC CREEK
 POTOMAC CREEK WATERSHED
 STAFFORD CO. MD. 25 NIA
 CROSS SECTION
 U. S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE
 J. W. C.
 2-330-2



SCHEMATIC PLAN OF CUTOFF TRENCH



PROFILE OF DAM

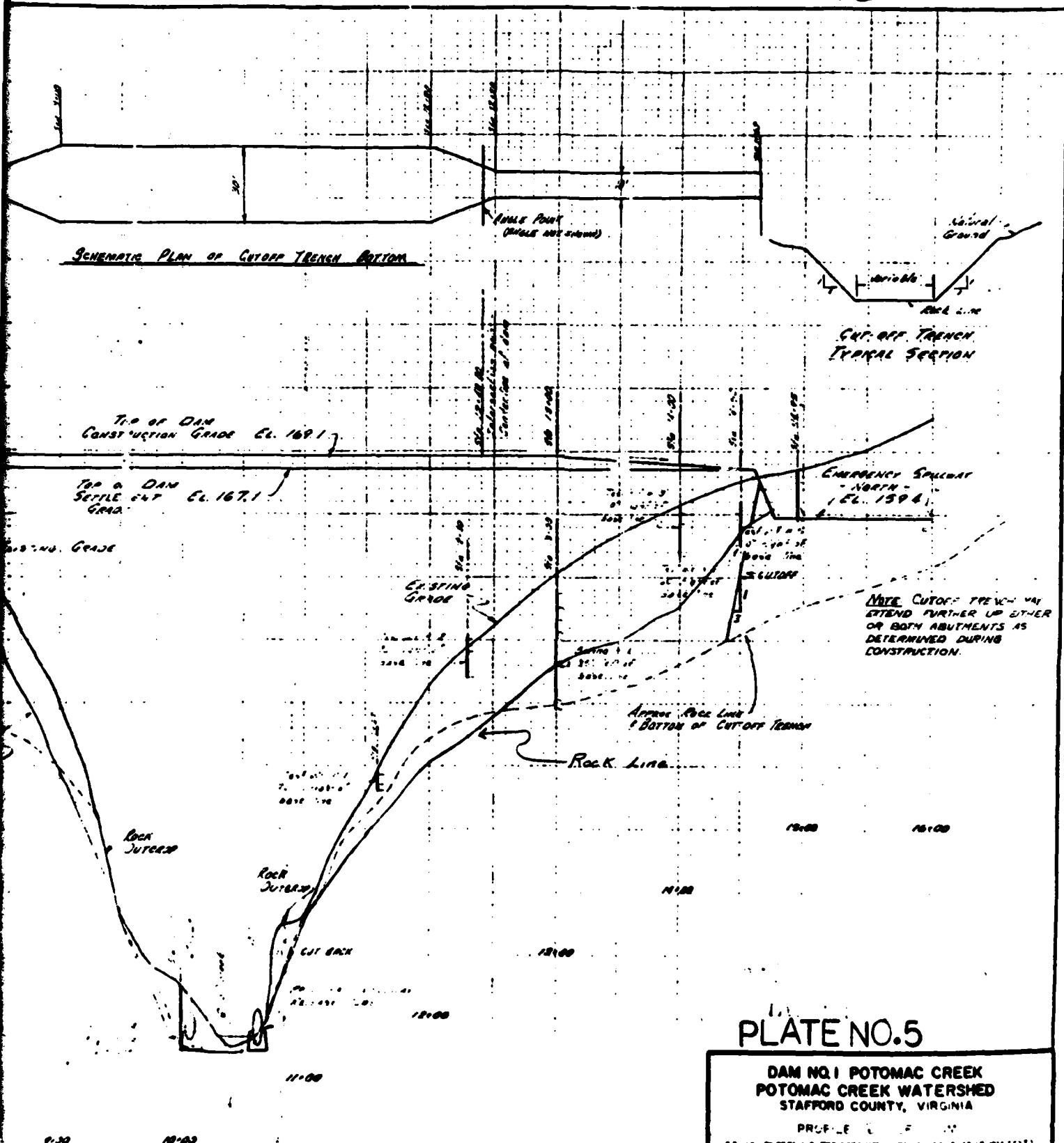


PLATE NO.5

DAM NO.1 POTOMAC CREEK
POTOMAC CREEK WATERSHED
STAFFORD COUNTY, VIRGINIA

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PROJECT NO.	DATE
BY	SCALE
CHECKED BY	APPROVED BY
DATE	DATE
FILE NO.	VA - 530 - 5

DRAIN PIPE NOTES

1. All drain pipes shall conform to specifications 112 and 113, and shall be 10" dia. heavy wall 2" thick, have at least 2 and no less than 2.
2. All drain pipes shall be laid with perforations down.
3. The profile of new line is approximate. The actual finished grade will be determined by the contractor.

12" PIPE RECOMMENDATIONS

1. 12" dia. and 2" thick
2. Small at the point of entry and increase to 10" dia. at the outlet
3. 12" dia. at the outlet
4. 12" dia. at the outlet
5. 12" dia. at the outlet
6. 12" dia. at the outlet
7. 12" dia. at the outlet
8. 12" dia. at the outlet
9. 12" dia. at the outlet
10. 12" dia. at the outlet

CHIMNEY DRAIN EL. 140

2' THICK 14.25"
4' THICK 14.95"

Fill

5' THICK 14.50"

Existing Grade

Proposed Pipe Line

MINIMUM 2" THICK DRAIN PIPE
BLANKET FROM CHIMNEY DRAIN TO DRAINAGE
ICE & SNOW BARRIER DRAINAGE
CAPTURED AT DRAINAGE TO BE REMOVED
THE DRAINAGE SYSTEM

See sheet 2
for details of drain
pipe proposed spillway outlet

ING UP-STREAM
P. LINE. PROFILE
OF
CHIMNEY DRAIN

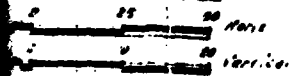


PLATE NO. 6

DAM NO. 1 POTOMAC CREEK
POTOMAC CREEK WATERSHED
STAFFORD COUNTY, VIRGINIA

DRAIN CHIMNEY DETAIL
DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DRAIN PIPE NOTES

1. All drain pipes shall conform to specifications 112 and shall be 10" dia. Gauge shall be 2.0 mm. All joints shall be made with pipe and no couplings.
2. All drain pipes shall be laid with perforations down.
3. The profiles of rock line are approximate. The required finished grade will be determined by the engineer.

10" PIPE REQUIREMENTS

1. Metal and cap.
2. Small at end guards mounted on non-perforated section.
3. 100' above perforated pipe.
4. 10" perforated pipe.
5. 10" non-perforated pipe. 20' to be placed on each side of principal spigot at the filling basin.

CHIMNEY DRAIN EL. 140

2' THICK
A' THICK - 1.950"

Fill

5' THICK
92.500"

EXISTING GRADE

SHARP ROCK LINE

MINIMUM 2" THICK DRAIN FIL
BLANKET FROM CHIMNEY DRAIN TO DOWNSTREAM
FOR 4 DRAIN BLANKET DRAIN WOULD BE
CARRIED AT DOWNSTREAM TO 10' FROM 100'
THE DRAIN DRAIN (100').

See sheet 6
in detail of area
other personal auxiliary work

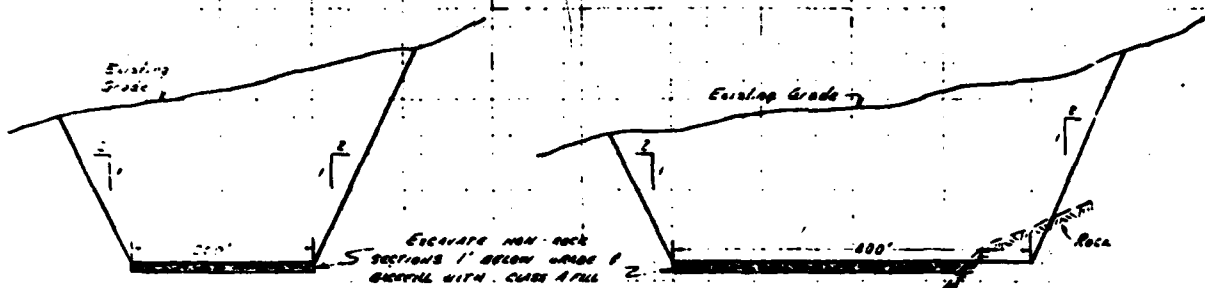
UP-STREAM
R. LINE. PROFILE
OF
CHIMNEY DRAIN.

0 15 30 Feet
0 30 60 Feet

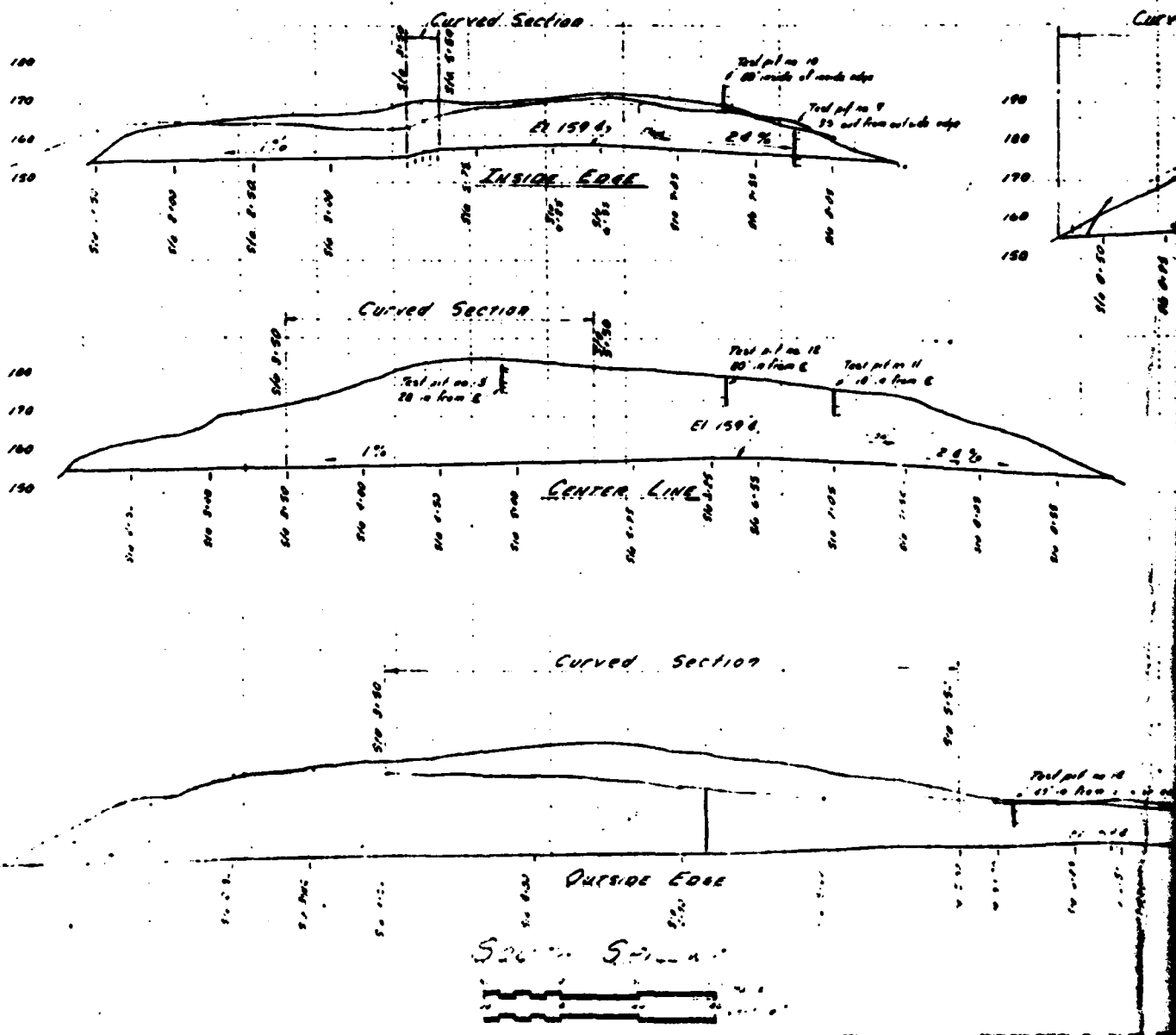
PLATE NO. 6

DAM NO. 1 POTOMAC CREEK
POTOMAC CREEK WATERSHED
STAFFORD COUNTY, VIRGINIA

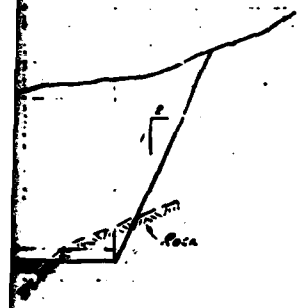
DRAIN, CHIMNEY DETAIL
DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE



TYPICAL SECTION OF SPILLWAYS

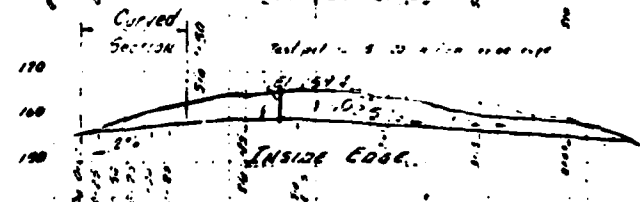
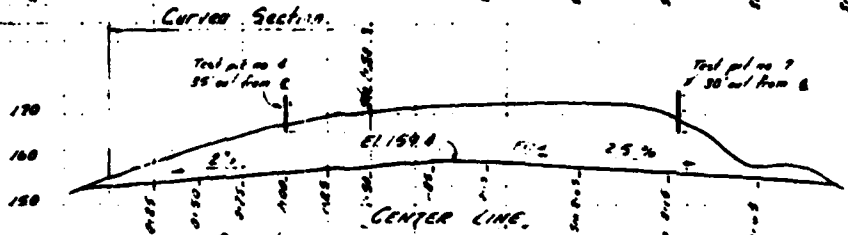
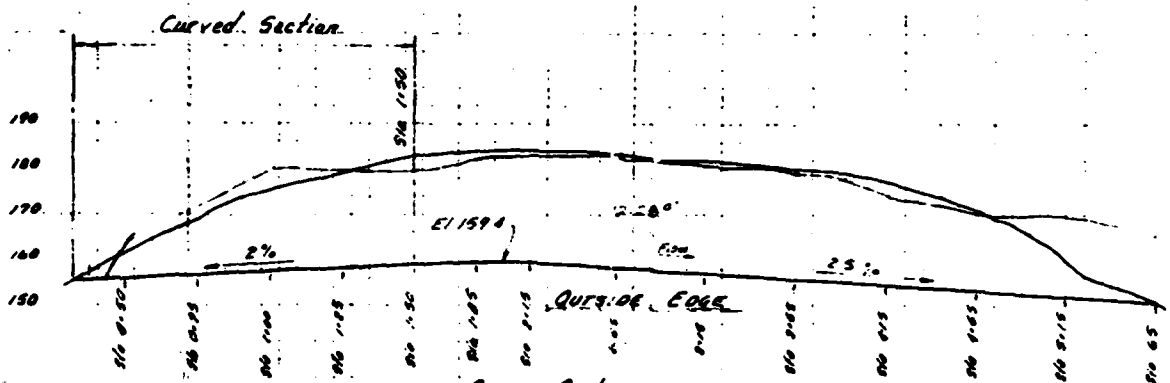


N



Test pit no 10
Side of road edge
Test pit no 9
35' out from outside edge

Test pit no 12
from C
Test pit no 11
10' in from C



NORTH SPILLWAY

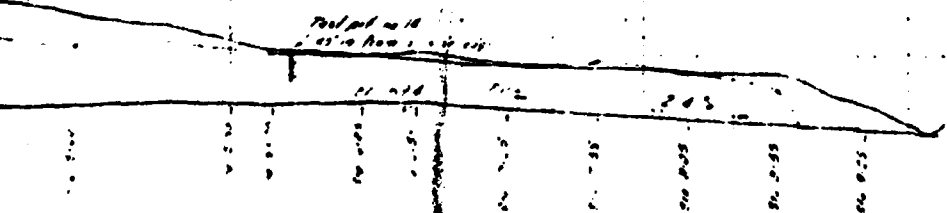
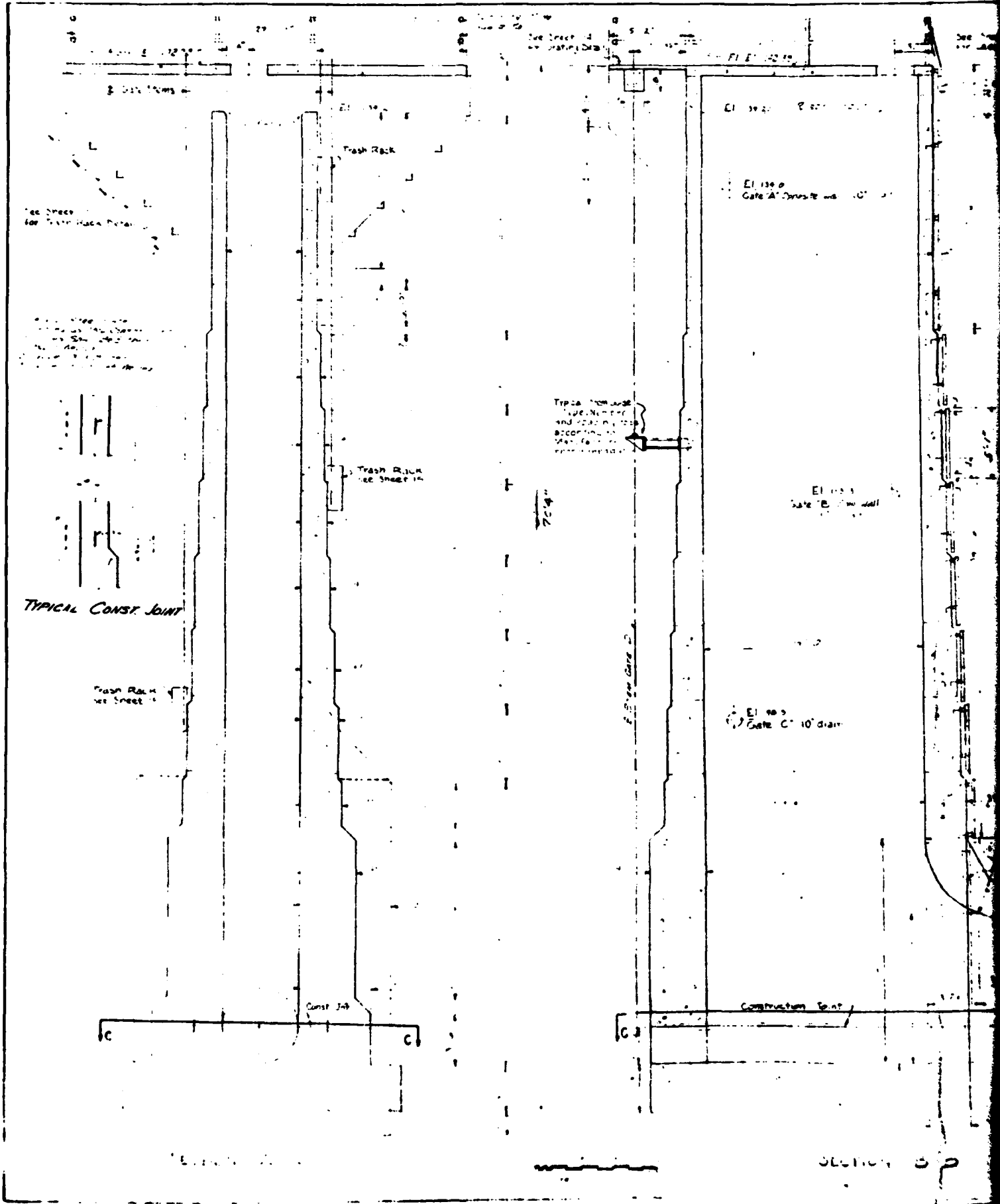
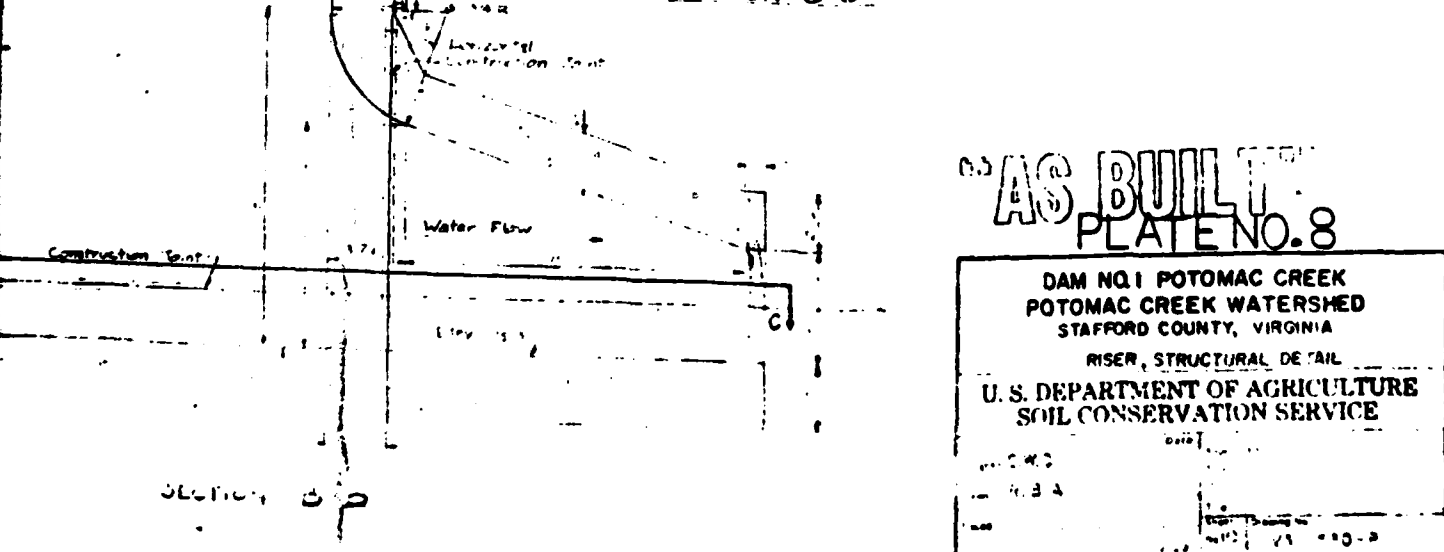
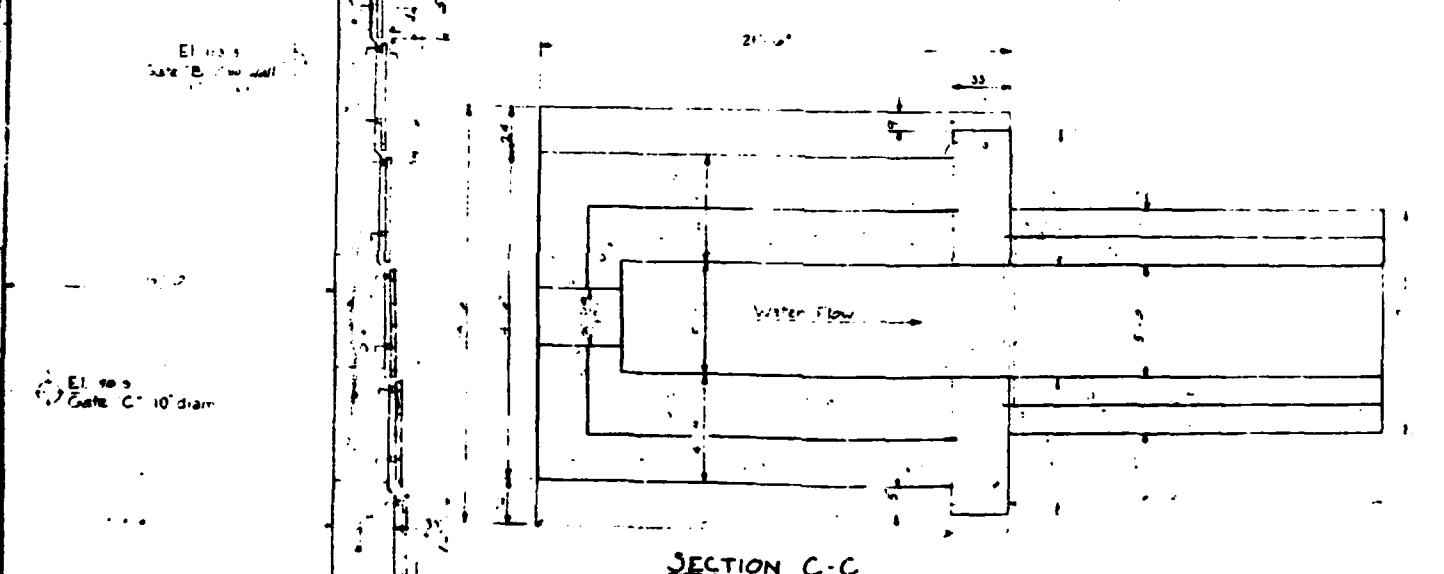
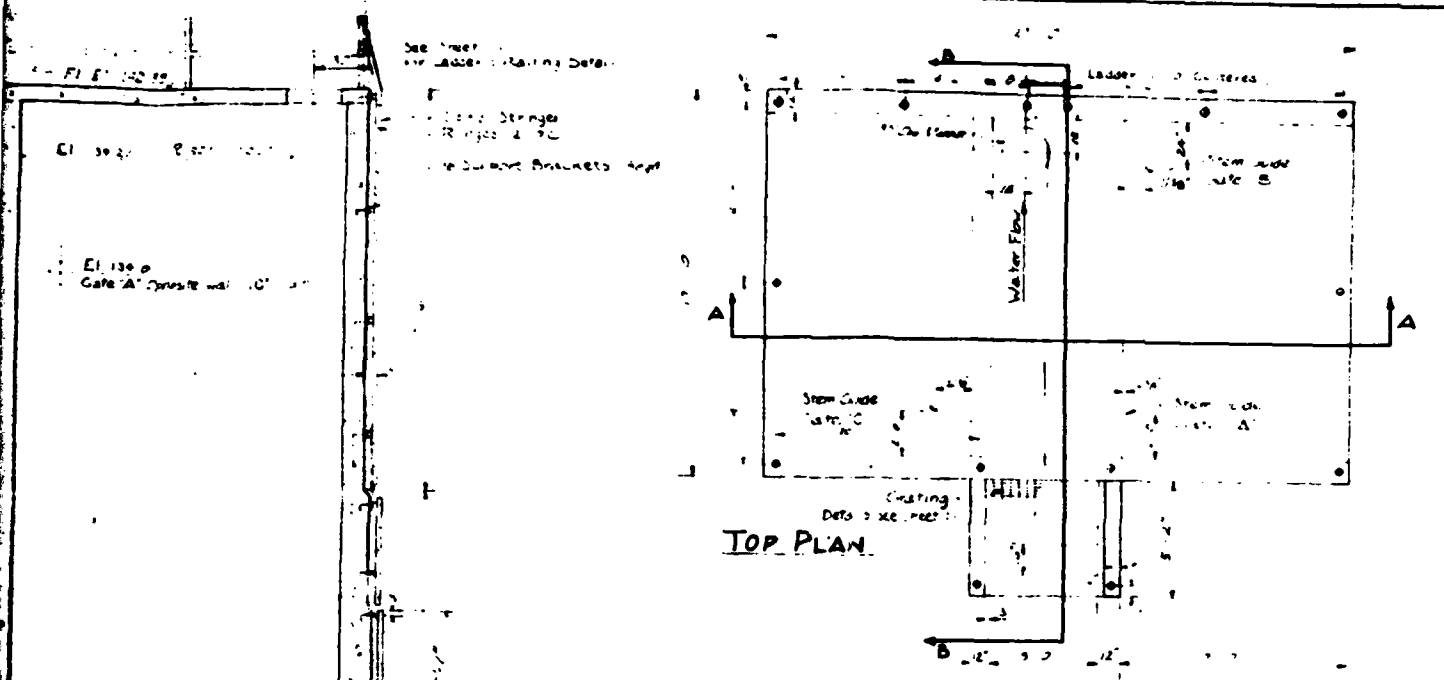


PLATE NO. 7

DAM NO. 1 POTOMAC CREEK
POTOMAC CREEK WATERSHED
STAFFORD COUNTY, VIRGINIA
PROFILES OF EMERGENCY SPILLWAY
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE





"AS BUILT"
PLATE NO. 8

DAM NO. 1 POTOMAC CREEK
 POTOMAC CREEK WATERSHED
 STAFFORD COUNTY, VIRGINIA

RISER, STRUCTURAL DETAIL

U. S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE

DATE: 11-1-55

BY: [Signature]

CHECKED: [Signature]

APPROVED: [Signature]

APPENDIX II
PHOTOGRAPHS

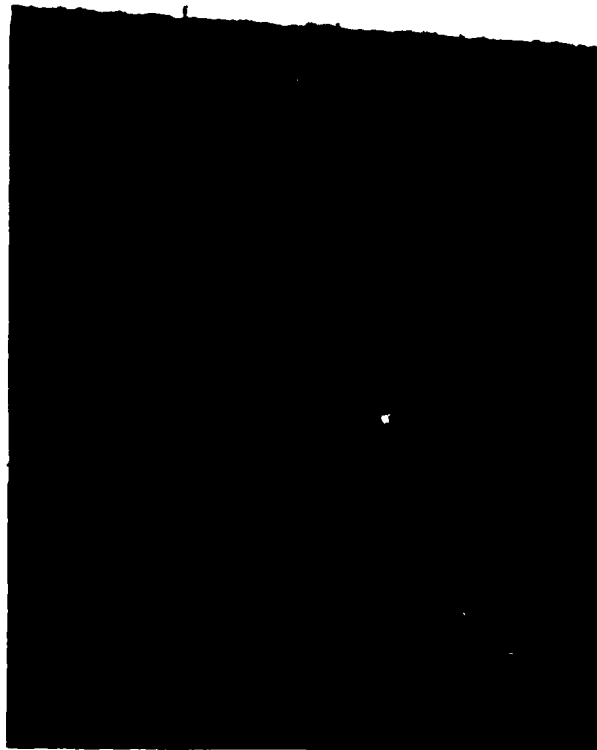


PHOTO NO. 1
DOWNSTREAM FACE OF DAM



PHOTO NO. 2
DOWNSTREAM CHANNEL



PHOTO NO. 3
LEFT EMERGENCY SPILLWAY



PHOTO NO. 4
RIGHT EMERGENCY SPILLWAY (DOWNSTREAM SECTION)



PHOTO NO. 5
INTAKE STRUCTURE

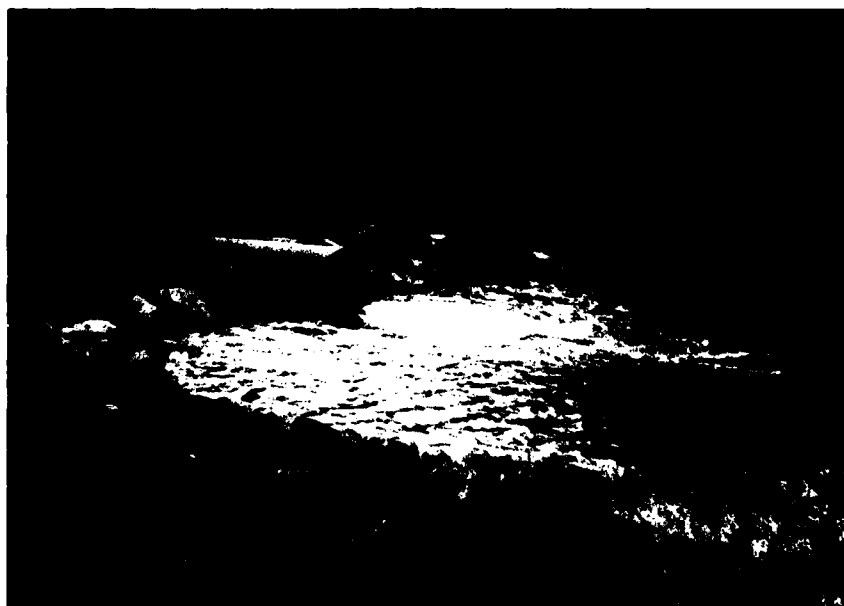


PHOTO NO. 6
OUTLET PIPE AND PLUNGE POOL



PHOTO NO. 7

INTAKE STRUCTURE AT LOW POOL ELEVATION DECEMBER 1979



PHOTO NO. 8

EMERGENCY SPILLWAY (RIGHT) JUNE 1972

APPENDIX III
FIELD OBSERVATIONS

Check List
Visual Inspection
Phase I

Name Dam Potomac Creek No. 1 County Stafford State Virginia Lat. 38° 23.4'
Coordinators Long. 77° 28.8'

Date(s) Inspection May 1, 1980 Weather Cloudy, Temperature 55° F
Light Rain

Pool Elevation at Time of Inspection 114 msl Tailwater at Time of Inspection 74 msl

Inspection Personnel:

Schnabel Engineering Associates, P.C.
Raymond A. DeStephen, P.E.
Stephen G. Werner (recorder)

J. K. Timmons and Associates, Inc.
Robert G. Roop, P.E.
Donald Balzer (recorder)

State Water Control Board
Ed Constantine

Russell and Axon, Engineers
Wayne Brooks (Owner's representative)

USDA, Soil Conservation Service
Don Farmer

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	The slopes, crest, emergency spillways and abutment contacts were inspected and no cracks were noted. The embankment and left emergency spillway were grassed (1-3 ft high) and included some brush. The right abutment was grassed except in the roadway section and eroded portion of the downstream channel. No vegetation exists on that portion of the upstream slope which was exposed as a result of the lowered lake level.	The grass should be cut. The roadway section should be paved or grassed in attempt to prevent surface erosion. The eroded portion of the channel should be corrected.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Some erosion due to four wheel drive vehicle traffic exists along the downstream face of the dam and the embankment crest. Severe erosion also exists along the left upstream slope near the left upstream abutment area where a small stream enters the impoundment area (See Photo No. 7, Appendix II). This erosion reportedly developed since the pool level has been lowered. Scattered shallow washes or gullies (less than 1 ft x 1 ft) were encountered along the lower half of the downstream slope. The 10 ft wide berm shown on the "as built" drawings for the upstream slope, directly below the riprap was not encountered.	Vehicle traffic should be prevented. Existing tracks should be backfilled with compacted soil and reseeded. The eroded embankment section on the upstream slope should be corrected before returning to normal pool level. The shallow gullies do not require any attention.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Appeared to be good.	
RIPRAP FAILURES	Two inch to 3 ft shale blocks exist along a 5 ft wide portion of the upstream slope at about normal pool level (See Photo No. 7, Appendix II). Some large blocks occur downslope from the main concentration of riprap. Riprap also occurs along the lower third of the embankment-abutment contacts of the downstream slope. Riprap lines the plunge pool. All of the riprap appeared to be in good condition.	The 10 ft berm shown on "as built" drawing along the upstream slope was not observed. It is unlikely riprap has moved downstream and covered the berm.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	<p>The embankment ties in well with the adjacent abutments. Shallow erosion gullies less than 1 ft x 1 ft occur intermittently above the riprap areas. The embankment appears to be constructed with clayey silt, some fine sand (MH). Fresh granite gneiss exposed in the left abutment area about 30 ft above the plunge pool. Measured foliation strikes 39° NE and dips 25°-45° SE. Jointing was also observed. Residual soils were exposed in the lower portion of the right emergency spillway. Foliation strikes 45° NE and dips 90°-75° SE. Residual soils appear to be granular. No faults were observed during the inspection</p>	<p>The erosion gullies do not require any attention.</p>
ANY NOTICEABLE SEEPAGE	<p>No seepage was observed. The pool level had been lowered approximately 25 ft below normal pool level as a result of construction of the nearby water treatment facility. A rather continuous thin (2 ft wide) wet or marshy zone was encountered approximately 35 ft above the top of the outlet pipe, extending 50 ft right and 100 ft left of the vehicle tracks (See Sheet 1). This may be the result of runoff accumulation.</p>	<p>The saturated area should be monitored once normal pool levels are resumed to verify that it is not caused by seepage through the dam.</p>
STAFF GAGE AND RECORDER	None observed.	A staff gage should be installed
DRAINS	<p>Two 10 inch CMP drains were observed, one on each side of the 5 ft outlet pipe. Clear water was flowing at approximately 1 gpm from each drain. The right drain was partially clogged at its outlet.</p> <p style="text-align: center;">III-3</p>	The right drain should be unstopped.

LEFT EMERGENCY SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	None	-
APPROACH CHANNEL	200 ft wide grassed channel	In good condition, grass needs mowing
DISCHARGE CHANNEL	Some erosion due to four-wheel drive vehicle traffic on the side slopes. Also some erosion in the downstream area.	Eroded areas should be reseeded and vehicle traffic prevented
BRIDGE AND PIERS	None	-
	Note: Maximum pool elevation was 6 inch to 1 ft above spillway in 1971 during	

RIGHT EMERGENCY SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	None	-
APPROACH CHANNEL	Grass in good condition, but need mowing. Some erosion due to vehicular traffic. Miscellaneous debris from construction is scattered in channel.	Road area could be surfaced. Grass should be cut and debris removed.
DISCHARGE CHANNEL	Downstream is heavily eroded as a result of the 1971 flood and erosion continues during normal runoff.	Repair erosion and reseed.
BRIDGE AND PIERS	None	-
	III-5	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed in 60 inch pipe	Good condition.
INTAKE STRUCTURE	Concrete in good condition. Top gate is missing. The two valves are reportedly operational.	Top gate (10 inch) should be replaced
OUTLET STRUCTURE	None	-
OUTLET CHANNEL	Riprap in plunge pool is intact and functional	Good condition
EMERGENCY GATE	Reportedly in operational condition III-6	-

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	2.5H:1V to 3H:1V natural graded slopes exist below normal pool. Wooded gentle to moderate slopes (3H:1V average) bound the reservoir. No debris was observed along the shoreline.	Good condition
SEDIMENTATION	None observed	—

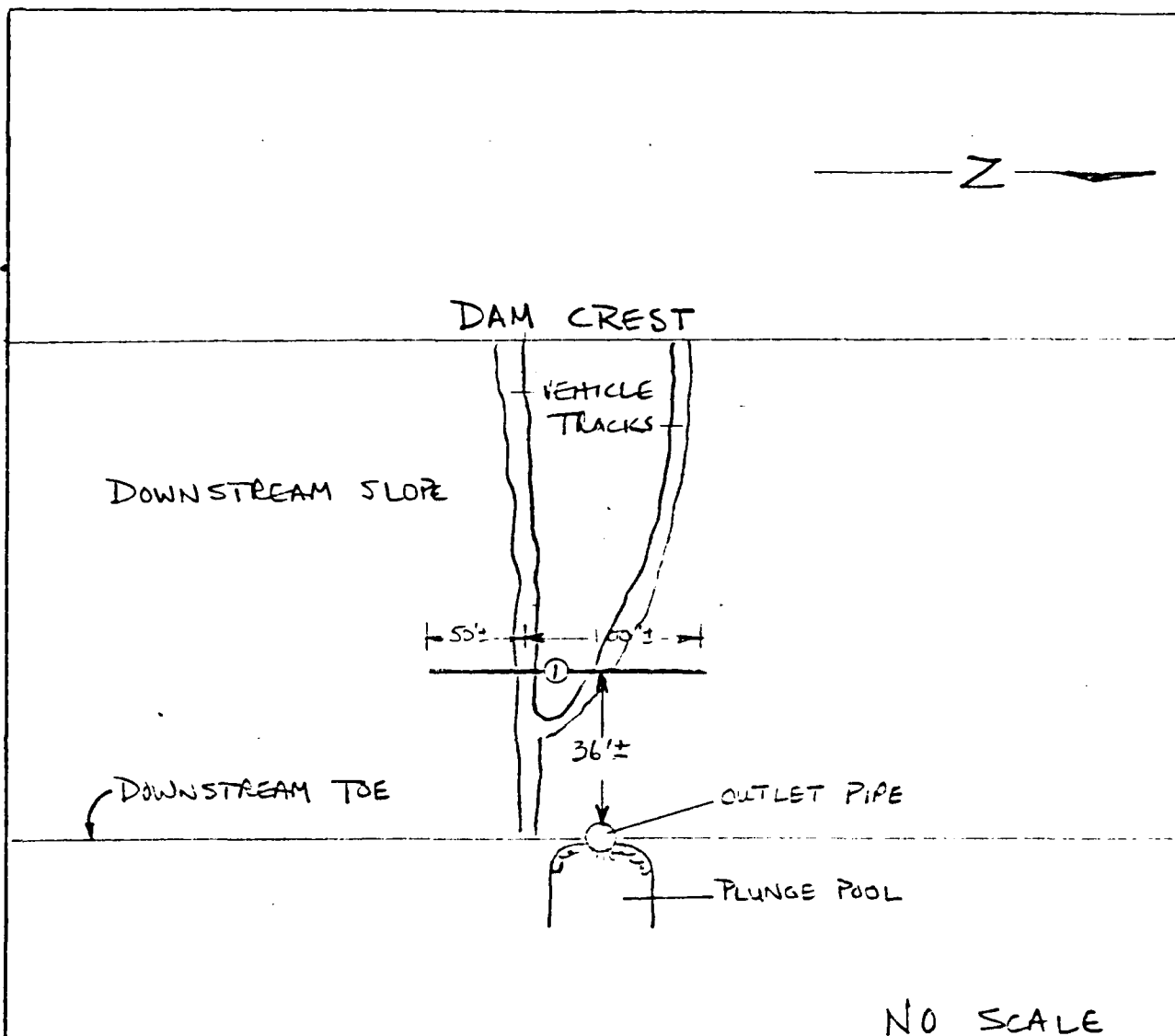
DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	No debris; surrounding area is wooded Channel includes earth and rock bottom. N = 0.10 above creek banks	Good condition
SLOPES	3H:1V side slopes occur in the flood plain. Lower portion is 35 ft wide	-
APPROXIMATE NO. OF HOMES AND POPULATION	Two miles downstream at U.S. Route 1: 1 motel approximately 10 ft above the streambed and 1 commercial dwelling approximately 12 ft above the streambed.	Motel has been flooded before

INSTRUMENTATION		REMARKS OR RECOMMENDATIONS
VISUAL EXAMINATION	OBSERVATIONS	
MONUMENTATION/SURVEYS	None	-
OBSERVATION WELLS	None	-
WELLS	None	-
PIEZOMETERS	None	-
OTHER	III-9	

BY SW DATE 5/1/80 SCHNABEL ENGINEERING ASSOCIATES
CONSULTING ENGINEERS
CHKD BY DATE
SUBJECT FIELD SKETCH - SATURATED ZONE

SHEET NO 1 OF 1
JOB NO. Y80105



① THIN SATURATED ZONE 2'± WIDE
AND 150'± LONG

APPENDIX IV
DESIGN REPORT SUMMARY

... 6 ... of this report together with the ... Virginia, 71/1 - ... and ... published by the U.S. Geological Survey may be used to locate the structure.

A summary of pertinent design information is given on sheet 3 and 4 of this report.

Criteria and procedures used in this design are given in the following Soil Conservation Service publications:

- National Engineering Memorandum No. 27, Limiting Criteria for the Design of Earth Dams
- National Engineering Memorandum No. 59, Drop Inlet Spillway Standards
- National Engineering Handbook No. 4, Hydrology
- National Engineering Handbook No. 5, Hydraulics
- National Engineering Handbook No. 6, Structural Design
- National Engineering Handbook No. 8, Geology
- Engineering Division Technical Release No. 8, Earth Spillways
- Engineering Division Technical Release No. 5, Structural Design of Underground Conduits
- Engineering Division Technical Release No. 10, Storage-Floodwater Retarding Structures
- Engineering Division Technical Release No. 12, Procedures for Computing Sediment Requirements for Retarding Reservoirs
- Water Bureau Technical Paper No. 40

This is a flood retarding and municipal water storage structure designed to reduce flooding in the Potomac Creek watershed, and to provide water storage and supply for the immediate needs of Stafford County.

The results of hydrologic and hydraulic computations are given on sheet 5 of this section of the report.

The structure consists of a compacted earth fill extending to firm unweathered rock. The upstream zone of clay material is followed with a filter chimney after which, the downstream zone of decomposed gneiss is compacted over a filter blanket. A rock drain is located under the downstream toe.

The principal spillway is a reinforced concrete covered drop inlet type structure, consisting of a reinforced concrete riser, a transition section at the base of the riser, a 42-inch conduit, and a stilling basin to dissipate energy at the outlet end of the conduit. Three water supply gates are provided, at various elevations in the riser for release of water for municipal use. The riser base slab along with the entire pipe cradle of the conduit will be cast and embedded into dense rock. In addition, the stilling basin will be excavated in the same dense rock.

The emergency spillways will be excavated into various areas of clay, decomposed gneiss and sound rock. Certain sections of the spillways which are lower than design finished grade will be filled to proper elevation with excess quantities of rock excavation and capped with compacted clay material.

Soil conditions and soils engineering tests, are included in the report titled "Foundation Investigation" dated July 11, 1967, as prepared by Woodward-Clyde-Kerr Associates, Consulting Engineers of St. Louis, Missouri, whom as sub-contractors to the firm of Martin, Clifford & Associates, Consulting Engineers of Stafford, Virginia, conducted all geologic investigations and performed all soils engineering tests and analysis.

DESIGN REPORT SUMMARY

I. Watershed data

A. Structure class	C	
B. Drainage area	<u>14.5</u>	Ac.
C. Time of concentration - Tc	<u>1.5</u>	Hrs.
D. Hydrologic curve number - Cn		
1. Moisture condition II	<u>64.5</u>	
2. Moisture condition III	<u>-</u>	

II. Principal spillway

A. Conduit		
1. Size (I.D.)	<u>60"</u>	In.
2. Length	<u>55</u>	Ft.
B. Miser		
1. Size	<u>5 x 15</u>	Ft.
2. Height	<u>1.0</u>	Ft.
C. Weir length	<u>100</u>	Ft.
D. Pond drain size	<u>30 x 30</u>	In.
E. Type of energy dissipator	<u>None</u>	

III. Emergency spillway (2 provided)

1. North Spillway		
A. Width	<u>200</u>	Ft.
B. Side slopes	<u>2:1</u>	
C. Length of level section	<u>75</u>	Ft.
D. Exit slope	<u>3:1</u>	Ft.
E. Maximum velocity at control section (D.H.W.)	<u>1.1</u>	fps
F. Duration of flow (D.H.W.) through emergency spillway	<u>22.56</u>	Hrs.
G. Frequency of Use	<u>1</u>	
2. South Spillway		
A. Width	<u>400</u>	Ft.
B. Side slopes	<u>2:1</u>	
C. Length of level section	<u>235</u>	Ft.
D. Exit slope	<u>Variable</u>	
E. Maximum velocity at control section (D.H.W.)	<u>3.31</u>	fps
F. Duration of flow (D.H.W.) through emergency spillway	<u>22.56</u>	Hrs.
G. Frequency of Use	<u>1</u>	

IV. Earth fill

A. Height	<u>92</u>	Ft.
B. Volume		
Dam Embankment	<u>300.072</u>	C.Y.
Fill in E.M.S.	<u>117.601</u>	C.Y.
C. Compaction	<u>Varies</u>	

BY C. A. S.

DATE 11-1-54

SUBJECT

POTOMAC CREEK

SHEET NO. 4 OF 6

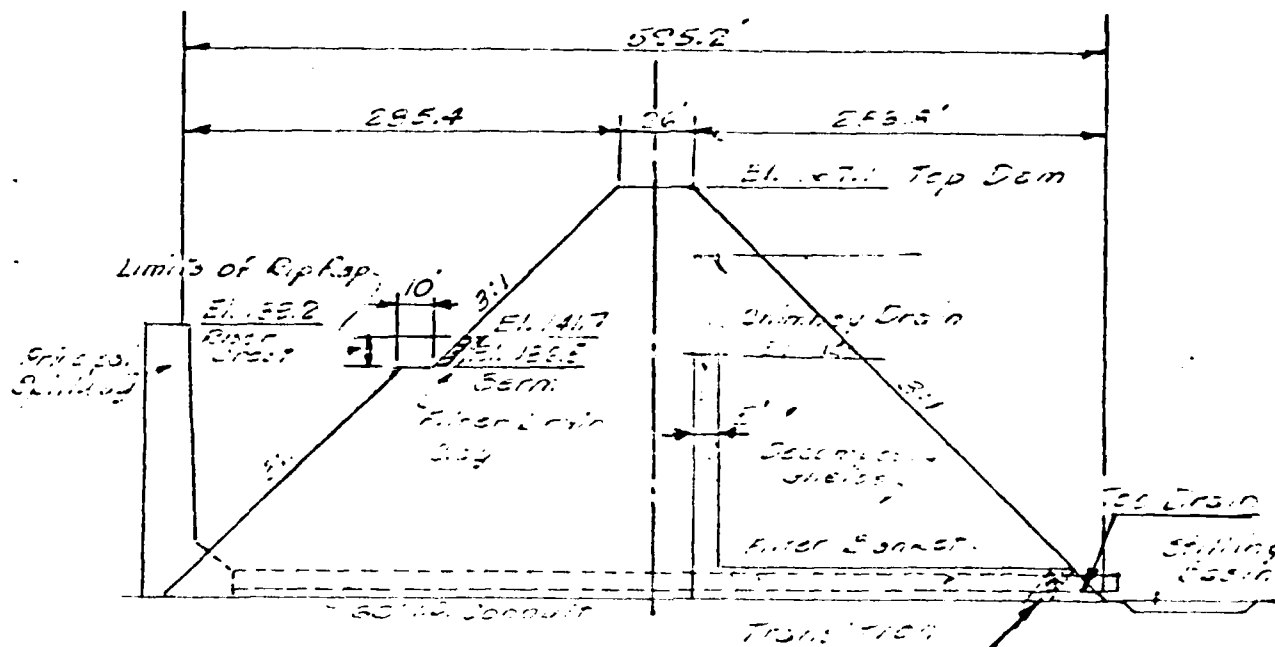
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DATE

WATERSHED - DAM NO. 1

JOB NO. VA-530-B

STATE OF VIRGINIA



TYPICAL CROSS SECTION

BY *G. J. C.*
CHECK BY

DATE *7/25*
DATE

SUBJECT

RECORD NO. *1*
ENTERED - *10/1/51*

SHEET NO. *1* OF *1*
JOB NO. *VA-511-E*
STATE OF *VA.*

Element of Structure	Determining Factor	Elevation	Surface Area Acres	Storage		Inflow		Peak Outflow C.F.S.
				Acres-ft.	Inches*	Volume Inches*	Rate C.F.S.	
Crest of riser	Water supply and 50-year sediment storage	139.2	185.0	3617.6	2.22**	--	--	0
Crest of emergency spillway	400-year frequency storm, moisture condition	159.4	312.0	8454.6	5.20**	--	--	745
Design high water	I X value from ES-1020 Sht. 4 M.C.II	163.6	348.0	9870.6	6.07**	9.48	15430	13500
Top of dam	I X value from ES-1020 Sht. 5 M.C. II	167.1	383.0	11,138.6	6.85**	22.53	36650	36450

IV-5

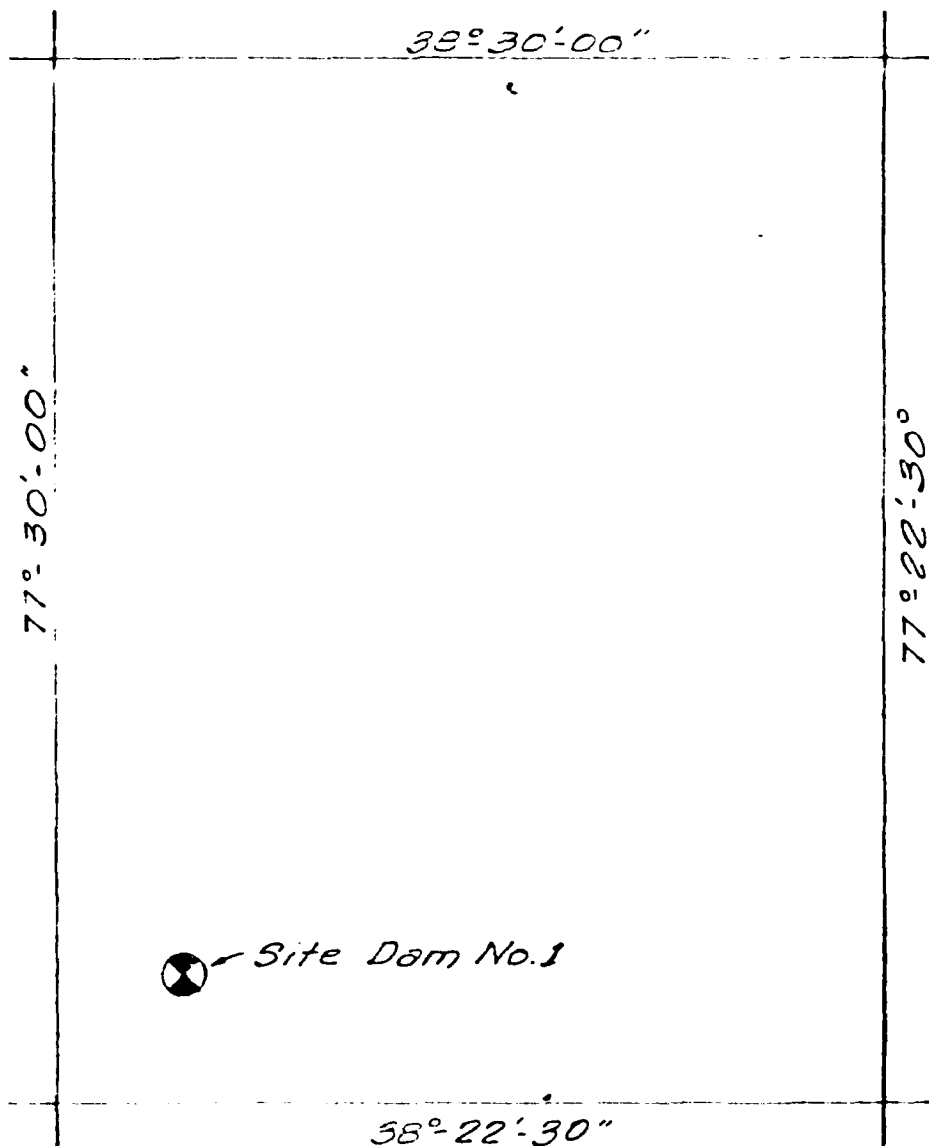
* Inches of runoff from controlled area of 19520 acres.
Time required to empty flood storage is 4.90 days.

** Available flood storage exclusive of aerated sediment.

DATE
DATE

SUBJECT POTOMAC CREEK
WATERSHED DAM NO. 1
LOCATION OF STRUCTURE

SHEET NO. OF
JOB NO. VA-530-B
STATE OF VIRGINIA



Reference:
U.S. 712' QUOC.
STATION 11.13.

SUMMARY OF RECOMMENDATIONS

EMBANKMENT AND FOUNDATION DESIGN

Analysis

(1) The total settlement of the crest from soil consolidation along the centerline of the embankment, and conduit, has been estimated in the range of one foot to two feet.

(2) Time rate of settlement computations indicate, that seventy-five percent of the total settlement will occur during the construction of the embankment. The remaining settlement is expected to extend over a period of eighteen months.

(3) The embankment has a minimum safety factor of 1.3 based on a ϕ angle of 26° in the decomposed gneiss section.

(4) It is estimated that the quantity of seepage is 126×10^{-5} ft.³/sec. This is based on a permeability factor of 1×10^{-5} cm/sec. with the water surface at elevation 140. Freatic surfaces will not have sufficient time to develop at higher water surface elevations.

Design

(1) Borrow sources are indicated by the borings and test pits excavated in the borrow area and emergency spillway. The types of borrow materials and approximate available quantities are estimated as follows:

- a. Clay soils - 300,000 Cubic Yards
- b. Decomposed gneiss - 83,000 Cubic Yards
- c. Rock - 20,000 Cubic Yards. It should be wasted as indicated on the drawings and shaped to provide protection of the down stream slopes.

(2) No special foundation treatment is recommended. A cutoff, down to reasonably sound rock should adequately stop the seepage. The foundation materials in the valley floor are relatively incompressible except for the

thin clay layer over random sections of the valley. The boulders and gravels that that lie under the clay mantle are dense and present no slope stability problem.

Most of the decomposed gneiss under the foundation on the abutments will be removed by the cutoff trench excavation and there is no need for complete removal of this material based on slope stability calculations for the decomposed gneiss section of the dam.

It is recommended that the rock in the cutoff be inspected after excavation to determine its soundness. Some dental concreting may be needed.

The principal spillway conduit should be placed on first class concrete cradle. This cradle should extend into rock where possible.

(3) No limitation is required on the rate of embankment construction. The clay soils should be compacted at a water content of two per cent higher than optimum, and obtain a minimum density of ninety-five per cent of Standard Proctor. The decomposed gneiss should be compacted at optimum water content to reach at least ninety-five percent of Standard Proctor density or it's equivalent.

Starting at the upstream slope, the placement of materials for a zoned embankment should be as follows: Rock and rip rap protection over a filter bed, where indicated, followed by the impervious zone of clay for the upstream portion of the embankment. Next is the chimney drain and the downstream zone of decomposed gneiss.

(4) The embankment design should have slopes of one, vertical to three, horizontal. Stability considerations do not require berms. An allowance of two feet of overbuild should be made for settlement of the crest.

(5) The chimney drain on the down stream side of the embankment should be at least 5 feet wide based on calculations of seepage quantities. The material in the drain chimney should have a permeability of at least 1.37×10^{-3} cm/sec.

The material found in the Kendall's Pit of the Fredericksburg Sand and Gravel Company should be suitable. It will be more than adequate if the fines are washed out. The chimney drain should include drainage pipes to carry out the seepage water rapidly.

PRELIMINARY DESIGN SUMMARY

(1) The dam is to be situated in a V shaped valley, characteristic of the Eastern Piedmont Province. The structure as presently planned is to consist of an earth fill dam approximately one hundred feet high above the existing stream flow line. The embankment will impound the run-off for a thirty-three square mile water-shed drainage area with an intended pool elevation of 140. The embankment and foundation design was initiated by an exploratory program consisting of auger borings, rock corings and test pit excavations. A geological investigation examined rock outcropping over the dam site proper and within the reservoir area.

The results of the field investigation indicated that the site has a relatively thin mantle of overburden soils consisting of sand silt and clay mixtures, underlain by rock consisting of decomposed gneiss followed by more resistant sound gneiss rock. The dam foundation must be cleared of all overburden soils, decomposed and weathered gneiss. The required depths of stripping in the emergency spillway is expected to penetrate sound gneiss and provide some rip rap. The recommended dam structure can consist of either a zoned or homogeneous embankment. The clay type soils removed from under the dam and the emergency spillway, can be used for the impervious upstream portion of a zoned embankment or for an entire homogeneous embankment. Decomposed gneiss can be used for the downstream portion of a zoned embankment. The embankment materials should be carefully controlled and compacted in place to a density, no less than ninety-five percent of Standard Proctor density. Tension cracking due to differential

settlement of the embankment presents a serious design problem. Consideration should be given to protection of the one on three slopes of the embankment with rip rap over a filter blanket. A five foot wide chimney drain should be placed in the downstream portion of the fill to collect seepage and eliminate pore water pressure in the foundation.

An alternate emergency spillway design was considered where in a single spillway was proposed on the southside consisting of a width of 600 feet plus the provision of two splitter dikes. On completion of the preliminary designs, subsequent computation revealed an excessive amount of material would have to be wasted, therefore, the alternate plan was abandoned.

(2) The embankment section in addition to being derived by an approximate stability analysis, was significantly influenced by experience and judgement.

Data used in the design included the results of the field investigation and pumping tests. Additional data was obtained from the laboratory test results. These tests included triaxial compression tests, consolidation tests, tests for soil index properties, Atterberg limits, grain size distribution curves, compaction curves, Los Angeles abrasion tests and permeability tests.

(3) Design criteria for the impervious section of the embankment, requires sufficient plasticity in the clay material, to inhibit the development of cracks, resulting from differential settlement. The compaction water content of the clay soils has therefore been recommended at two percent greater than the optimum water content. Compacted densities are to be no less than ninety-five percent of Standard Proctor density. Borrow materials for the impervious zone were selected on the basis of having a permeability coefficient less than 1.0×10^{-5} centimeters per second.

The following design criteria are considered conservative, and were used as a guide but not specified in the selection of materials for the drains

and filter layers: the fifteen percent (15) of the filter or drain material is at least five times as large as the D15 size of the soil being protected. The D15 size of the filter or drain material is not larger than five times the D85 size of the protected soil.

The gradation curve of the filter or drain material has roughly the same shape as the gradation curve of the protected soil.

The filter and drain material were required to have no more than five percent fines, passing the number two hundred sieve, with the fines being cohesionless.

(4) The alternate design to the zoned embankment, is a homogeneous embankment comprising compacted clay soils for the upstream and downstream sections on each side of the vertical chimney drain. Consideration of the zoned embankment was influenced by maximum utilization of available materials. It is believed that substantial quantities of decomposed gneiss will be made available from the excavations. This material forming the downstream section of the embankment, may be difficult to place and compact. Excavated quantities may contain large sized that are difficult to breakdown. In addition, the decomposed gneiss will be more subject to cracking from differential settlements than the plastic clay soils. Downstream of the chimney drain, the results of cracking may be less significant, although some loss in slope stability may occur.

(5) The catwalk normally provided to the principal spillway is not recommended in this instance, in view of its intermittent use, and the excessive length of approximately 200 ft. required for its construction. In addition, it is felt the cost of the excessive height of the supporting piers along with the balance of the structure are not economically justified. In lieu thereof, an exterior ladder will be provided for access, at such time as the pool is below normal level.

DATE
DRAWN BY

DATE

PROJECT - 100-100-1

STATE OF VIRGINIA
DEPT. OF HIGHWAYS
DIVISION OF HIGHWAYS

(C) It was apparent during the design of the conduit, that submergence would occur during maximum design flow. In order to establish the depth of submergence cross-sectional surveys of the downstream portion of the creek lying between Sta 240+00 (centerline of the dam) and Sta 270+00 were conducted, and are analyses were made to approximate the flow characteristics of the stream.

The method of analysis used was an approximate one, using Mannings Formula, and the trial and error method to determine water depth. It was found, the depth of water in the creek at the discharged side of the stilling basin would approximate 6'-9" depth at the time of maximum spillway discharge.

It is evident from the above data, that a considerable amount of re-grading, reshaping, including a great deal of rock excavation will be necessary to prevent submergence of the conduit outlet.

APPENDIX V
PREVIOUS INSPECTION REPORTS

OPERATION AND MAINTENANCE INSPECTION REPORT

Watershed: Abel Lake

Date: June 20, 1979

Inspected by: R. E. Sotzing - Stafford Sanitary District, Wayne Brooks - Russell & Axon, Jean Jones - Tri-County SWCD, Jim Blodgett and Don Farmer - Soil Conservation Service.

1. As in the past, most of the erosion on this site can be attributed to the excessive amount of vehicular traffic. The access road is deeply rutted and should be regraded. Trails still exist in the emergency spillway and across the dam. And although 4-wheel activity seems to have subsided on the downstream face of the dam, some ruts still exist.

It was felt by all those present that this vandalism would be reduced once construction begins on the water treatment plant. During that period, the above exposed areas will be reseeded to provide vegetative protection.

2. In general, the vegetation is in good shape. However, it was recommended that a soils test be taken so that maintenance lime and fertilizer could be applied. It was also suggested that occasional mowing would not only control weeds but would stimulate additional growth of the Sericea and fescue.
3. No woody vegetation was noted.
4. The principal spillway and foundation drains appeared to be operating properly. As previously noted, the ten-inch water control gate is missing.

OPERATIONS AND MAINTENANCE INSPECTION REPORT

Watershed: Potomac Creek, Site #1

Date: June 14, 1978

Inspected by: Albert Jefferies-Russell & Axon, Bob Wilkins-Stafford
County Sanitary District, Jean Jones-Director, Tri-
County SWCD, Jim Blodgett-Area Engineer and Don Farmer-
District Conservationist of the Soil Conservation Service.

1. The erosion problems on this site can be attributed to heavy vehicular traffic this area receives. The access road is rutted and eroded in several places and requires some repair. As mentioned, in past inspections, the top of the dam and spillway are still being abused as a roadway. These denuded areas are subject to erosion and could cause serious and expensive damage to the structure should water flow through the emergency spillway. In addition to the 'established' trails, 4-wheel drive vehicles have begun climbing the downstream face of the dam. Such activity is very detrimental to the stability of the structure.
2. The vegetative cover is in fair shape, but it shows signs of needing additional fertilizer and lime. These nutrients should be applied based on the recommendations of current soil tests and applied in the fall. To promote a more vigorous stand of vegetation, this area should also be mowed occasionally.
3. There was no evidence of any woody plants growing on or near the embankment. Trees are growing in the mouth of the emergency spillway and should be removed as soon as possible.
4. The principal spillway and the foundation drains appeared to be operating properly. As previously noted, the ten-inch water control gate is missing.

Although this structure is in reasonably good shape it has been subject to much vandalism. All the gates or barriers have been either cut down or knocked over. It also appears that this site is becoming more attractive to people with 4-wheel drive vehicles

OPERATION AND MAINTENANCE PLAN

Abel Lake

Stafford, Virginia

The County of Stafford is responsible for the proper operation and maintenance of this structure.

As part of the operation and maintenance, visual inspections will be made annually and after major storms. These inspections will include representatives of Stafford County, Tri-County Soil and Water Conservation District and the Soil Conservation Service. A report will be prepared after each of these inspections to document the groups findings, as well as, determining the type of maintenance required. A follow-up report will also be prepared showing the status of any required maintenance.

To sustain a vigorous stand of vegetation on the dam and spillway, the following maintenance should be performed:

- A. **LIME AND FERTILIZER** - Lime and fertilizer should be applied based on recent soils test. Generally, liming and fertilizing should be done every 2-3 years.

Apply lime and fertilizer between August 15 - October 1.

- B. **MOWING** - If possible to do safely mow the Sericea Lespedeza every 2-3 years in July 15 - August 15. However, it is not essential that the steep areas be mowed.

Do not mow below 4 inches.

- C. **BRUSH CONTROL** - All woody vegetation, trees, shrubs, etc. should be removed as soon as possible.

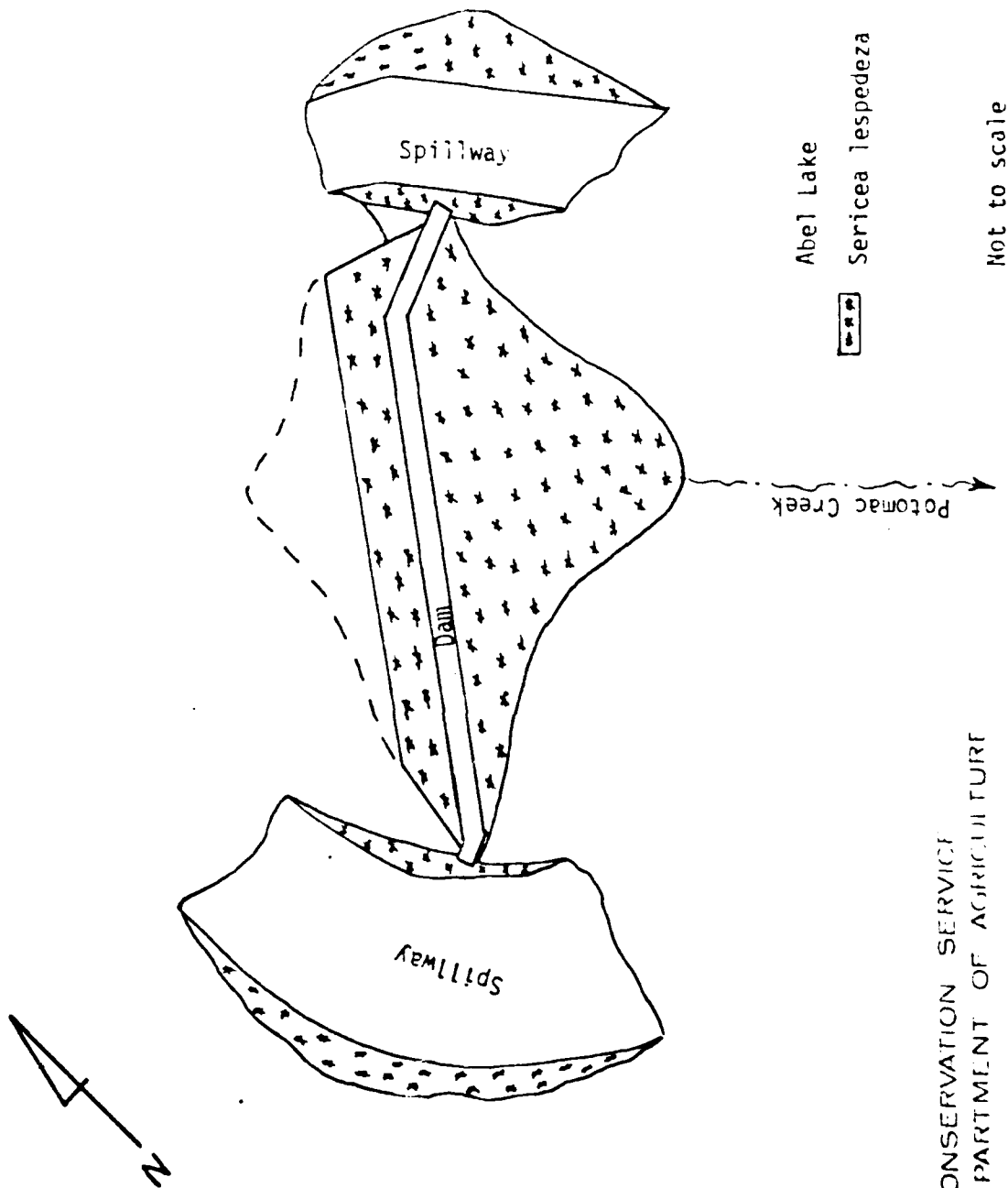
- D. **DEBRIS REMOVAL** - All debris that has been deposited by flows through the emergency spillway should be removed.

- E. **TRAFFIC** - 4-wheel drive or other vehicles should not be permitted on this site except to perform necessary maintenance.

OPERATION AND MAINTENANCE SCHEDULE

Abel Lake

Maintenance Item	When	Area	Approx. Cost	Date Completed
Fertilizing & Liming	every 2-3 yrs. Aug. 15 - Oct. 1	Spillway - 10 ac. 5 ac. Dam - 3 ac.	\$40/ac.	
Mowing	every 2-3 yrs. July 15 - Aug. 15	Spillway - 10 ac. 5 ac. Dam - 9 ac.	\$10/ac.	
Visual Inspection	Annually and after major storms	Dam, Spillway		



SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

APPENDIX VI REFERENCES

1. Recommended Guidelines for Safety Inspection of Dams, Department of Army, Office of the Chief of Engineers, 46 pp.
2. Design of Small Dams, U. S. Department of Interior, Bureau of Reclamation, 1974, 816 pp.
3. Geologic Map of Virginia, Virginia Division of Mineral Resources, 1963.
4. Section 4, Hydrology, Part 1, Watershed Planning, SCS National Engineering Handbook, Soil Conservation Service, U. S. Department of Agriculture, 1964.
5. Hydrometeorological Report No. 33, U. S. Department of Commerce, Weather Bureau, U. S. Department of Army, Corps of Engineers, Washington, D. C., April 1956.
6. Foundation Investigation Potomac Creek Dam and Reservoir, Stafford County, Virginia; Woodward-Clyde-Sherard and Associates, 1967.
7. Potomac Creek Dam and Reservoir, Test Results; Woodward-Clyde-Sherard and Associates, 1967.
8. Design Report, Dam No. 1, Potomac Creek Watershed Project, Stafford County, Virginia; USDA Soil Conservation Service, 1968.
9. Sand and Gravel Resources of the Coastal Plain of Virginia, Bulletin 32, Chester K. Wentworth, Virginia Division of Mineral Resources, 1930, 146 pp.